

Report of the working party on the private sector funding of scientific research

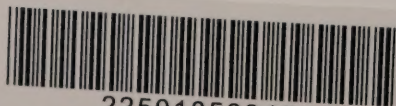
THE ADVISORY BOARD FOR THE RESEARCH COUNCILS was established by the Secretary of State for Education and Science in 1972 with the following terms of reference:—

- (a) To advise the Secretary of State on his responsibilities for civil science with particular reference to the Research Council system, its articulation with the universities and departments, the support of postgraduate students and the proper balance between international and national scientific activity;
- (b) To advise the Secretary of State on the allocation of the Science Budget amongst the Research Councils and other bodies, taking into account funds paid to them by customer departments and the purposes to which such funds are devoted;
- (c) To promote close liaison between Councils and the users of their research.

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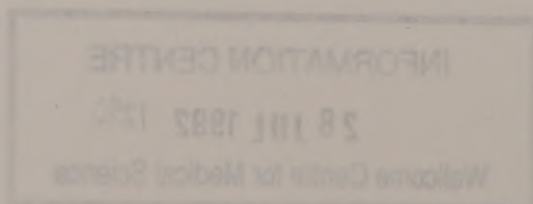
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May 1982

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Preface

1. The relationships revealed by this Report between scientific research and the financial resources required to finance it are complex. We do not see the boundary between public and private funding as a linear frontier which can be moved by a straight-forward substitution of resources. Hence no simple policy recommendations result. The spectrum of research in different fields of science ranges widely in the linkages between the advance of fundamental knowledge and its potentially profitable applications (not least in the time-scales involved). Such diversity invites, or demands, a matching diversity in funding. Moreover, the same research programme may experience a series of such different relationships in the course of its evolution over time.
2. In an increasing number of research fields (micro-electronics, the biological sciences and materials science, to name the most obvious) the advance of knowledge is seen to have important utilisable consequences, even though such 'strategic' research may be undertaken without precise future products or processes in mind. For strategic research in these fields much scope exists for greater participation by industry in joint funding with the universities/polytechnics and Research Councils. This 'triple alliance', in our view, should be fostered and will become of great importance. Industrial funders and academic scientists may have different objectives but both constituencies stand to gain from a joint awareness of each other's problems and of the common ground which both share.
3. Appreciation of the likely directions of progress towards practical developments can alert perceptions about potential advances in fundamental knowledge. As time-scales shorten in many fields awareness of progress in fundamental research becomes imperative for seizing potential opportunities for its exploitation. Collaboration between industry, the universities/polytechnics and the Research Councils (whether in a dual or a triple alliance) needs to be pursued at all levels and many different modes will evolve to effect this. However, greater awareness of such common ground and the possibility of shared objectives—by both sides—is a pre-condition for extended collaboration. In the course of our enquiry we sometimes felt that perceived reality reflected an earlier situation when such joint opportunities were more limited.
4. In many fields the categorisation of research as either 'basic' or 'applied' implies a false dichotomy, and impedes such interplay. However, our investigation concludes that, where long-term results are not seen to be orientated towards profitable exploitation (as with high-energy particle physics and astronomy), the responsibility for basic research is firmly regarded as a function of government and therefore of public funding. Where the objective of increased private provision is just to take the place of public funding of such fundamental research there seems little prospect of persuading industry, commerce and the charitable foundations to accept a wider role.
5. In the fields of shorter-term applied research much scope exists for the extension of contract work, consultancy arrangements, secondment of staff and other initiatives between industry, commerce, the financial world and universities/polytechnics and Research Councils. Much activity is in progress to extend the range and depth of such private funding and also for the universities/polytechnics and Research Councils to increase their earnings from the direct exploitation of research investments. The ending of the British Technology Group's monopoly of the right of first refusal of such commercial exploitation of publicly-funded research sets a new context in this respect, but many other institutional and attitudinal changes are needed before such potential gains can be harvested. Several of our recommendations seek to encourage such changes.
6. Present constraints on the public funding of research through the Civil Science Budget and the University Grants Committee funds have made all universities/polytechnics and the Research Councils alive to the need to increase their private earnings, benefactions and private funding from industry. Much effort,

which has yet to produce results in many cases, is currently being made, so this is a varied and fast-moving scene. Many individual instances of successful collaboration with industry in all its modes have been cited to us but we consider that, at present, such examples do not typify the general relationships between the 'external' research community and industry. There is need for instances of 'best practice' to be diffused more widely so that they become more representative. The spread of information about 'best practice' operations in these regards will itself encourage their diffusion.

7. For the reasons sketched above and investigated in more detail in our report we do not see scope for the direct diminution of public funding of research in the United Kingdom, if the essential research base is to be maintained and its potential realised for the future prosperity of the nation. Indeed, many of the opportunities for increased private funding depend upon the maintenance and enhancement by the public sector of the research base established in the universities/polytechnics and Research Councils. However, if the future potential for more extensive joint funding, collaboration with industry and direct earnings from publicly-funded research can be realised—and we see much scope for this—the total flow of research directly and indirectly funded by public provision will be enhanced and the proportion of public funding in the total research commitment will be reduced. In this sense the 'gearing' between public and private resources will have changed, to produce an increase in the total research effort, which we believe will be to the advantage of the national interest and the future prosperity both of the nation and of British science.

8. We believe that the case for such an increase in the total resources devoted to scientific research in the United Kingdom is strengthened by recent international comparisons. Current data for the principal industrial economies in the world reveal the disquieting fact that the percentage of the national income devoted to civil science research and development in the United Kingdom is much lower than that for our main competitors. This percentage has been declining on trends in the UK in recent years while it has been increasing in the case of the other countries. The implied correlations with industrial performance are depressing. Improved collaboration between private and public funding in the UK may prove to be a means of redressing this imbalance, by increasing the total flow of resources into civil research and development. By encouraging greater participation from private funds it may also help to redress another present imbalance (and the trend of recent years) in the total proportion of research and development in the UK being funded by industry—which is also significantly lower than in the United States, Germany and Japan.

9. The need to increase the flow of research funds from industry, universities, polytechnics and Research Councils is a pressing one. It is not enough to have a research base which is well funded and well equipped. It is also necessary to have a research base which is well managed and well organised. The need to increase the flow of research funds from industry, universities, polytechnics and Research Councils is a pressing one. It is not enough to have a research base which is well funded and well equipped. It is also necessary to have a research base which is well managed and well organised.

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Part 1—Introduction

1. The Working Party was set up by the Advisory Board for the Research Councils (ABRC) in October 1984 with the following terms of reference:—

- i. to investigate the funding by the private sector of scientific research in the fields of work supported by the Science Budget;
- ii. to find out about the present extent, nature and scale of this support; and
- iii. to assess the possibilities for its future extension and development and to report to the ABRC.

2. Our membership was as follows:

CHAIRMAN

*Professor P Mathias CBE FBA. Chichele Professor of Economic History at Oxford University and Fellow of All Souls College.

MEMBERS

*Professor Sir David Phillips FRS. Professor of Molecular Biophysics at Oxford University and Fellow of Corpus Christi College (Chairman of the ABRC).

Mr R A Artus, Group Chief Investment Manager, the Prudential Corporation.

*Sir Walter Bodmer FRS, Director of Research, Imperial Cancer Research Fund.

*Mr M F Wood OBE, Deputy Chairman, Oxford Instruments Group Limited.

Dr M A Darnbrough. Cabinet Office (appointed to provide a link with the Secretariat of the Advisory Council for Applied Research and Development (ACARD)).

SECRETARIAT

Mr K C Humphrey

Mr A K Soper (to September 1985)

*Member of the ABRC

3. For three months the Working Party had the benefit of the services of Miss J A Jones who was seconded to us full-time for that period by Morgan Grenfell Plc to work with us as a consultant and to conduct interviews with representatives of industrial and city companies. The work carried out by Miss Jones proved of considerable value to the Working Party and we should like to place on record our very warm thanks to her and to her employers.

THE BACKGROUND TO THE STUDY

4. The Working Party was set up in the wider context of the Government's desire to seek ways of containing public expenditure and to encourage publicly-funded bodies to attract more resources from the private sector of the economy, from charities and from private individuals. Scientific research, of course, has not been especially singled out for such an exercise: the current emphasis on seeking private funds covers much of the field of public activity in this country, including health care, aspects of education, the arts and sport. It was, however, explained to us that the origins of the study lay in the interest of Education Ministers in reducing the involvement of the state where possible and appropriate; in the possible establishment of new modes of support and collaboration which might augment—or make possible some reduction in—the proportion of state funding required in the future; and in encouraging more private funding of research by industry or others. We are therefore particularly concerned to investigate views about present constraints—organisational or otherwise—which were considered to limit the flows of private money into research.

5. In the informal discussions leading up to the establishment of the Working Party when, as noted above, the interest of Ministers in the various aspects of this study was emphasised to us, our attention was drawn to the possible scope for 'privatisation' of some aspects of the Research Council system. We share the widespread dislike of this word but can find no more convenient expression to embody the general idea of moving certain institutions or activities from public to private funding and control. We did not make specific investigations about individual institutes and facilities, which would have been beyond our terms of reference and resources, but we offer some comments later in this report (paragraphs 82–88).

6. In asking us to undertake this work the ABRC recognised that other claims on the time of our members and of the secretariat and other officials in Science Branch at the Department of Education and Science would preclude a detailed and lengthy study. We were accordingly asked to regard our study as a limited examination of the prospects, making use of what data already existed (if in scattered and not-readily available sources) and drawing freely upon published material. It was explained to us by the Board that, if our findings suggested that a more detailed study seemed worthwhile, perhaps on some particular aspect, the possibility of mounting a follow-up exercise could always be examined once we had reported. Finally, it was made clear to us that this was in no sense a fund-raising exercise—a point which we in turn sought to emphasise to all the outside bodies we met.

OUR APPROACH TO THE REMIT

7. These constraints of time and staffing imposed limits on the extent of this enquiry and the methods we could deploy to acquire information. We have had to take account of published or other available material and to draw on the work of the other bodies known to have made some examination of aspects of funding that were within or close to our own terms of reference. We concluded that it would not be feasible to make a study of overseas comparisons, to mount a programme of visits to commercial concerns or academic institutions, or to distribute a large-scale questionnaire. On the basis of information available within our membership and advice from outside sources we decided to meet senior staff from a limited number of widely different industrial companies, venture capital interests and major charitable foundations and to seek additional views from representative bodies such as the Confederation of British Industry (CBI), the Committee of Vice-Chancellors and Principals (CVCP) and relevant staff associations in further and higher education. Given the nature of our remit we accepted from the outset that we would need to seek oral and written evidence from each of the five Research Councils.

8. We should like to record our thanks to all those who met us for discussions or who submitted written evidence to us. The meetings we held with senior industrialists, venture capital executives and representatives of the major foundations were both stimulating and informative. A list of such meetings and written submissions is given in Annex K.

9. When Miss Jones was seconded to us we were able greatly to widen our industrial coverage. Miss Jones interviewed representatives of 34 companies (see Annex L) and provided us with a very helpful report of her discussions at the end of her secondment.

10. At this juncture it may be helpful if we explain how the terms of reference (paragraph 1. above) have been interpreted by the Working Party. The terms of reference of our parent body, the ABRC, provide that the Board shall 'advise the Secretary of State on his responsibilities for Civil Science with particular reference to the Research Council system, its articulation with the universities and departments...; [and] promote close liaison between Councils and the users of their research'. In this context we have seen our own remit as requiring us to lay our main emphasis on the needs of the Research Councils but necessarily to pay due attention also to the universities and other institutions of higher education which attract research grants from the Councils and whose students receive Council postgraduate awards. There is a further point: given the general nature of the current emphasis on seeking private funding all the various institutions conducting scientific research funded in whole or in part from public funds—Councils, universities, polytechnics, government laboratories, research associations and the like—are, in a very real sense, in competition for resources and it would not have been sensible for us to exclude the academic institutions from the scope of our study. The Working Party has, however, been conscious of the need to avoid duplication of work already done in or on behalf of the academic community. We also did not wish to penetrate into aspects of the university system which are essentially the concerns of the individual institutions or their governmental agency (University Grants Committee (UGC)) and collective organisation (the Committee of Vice-Chancellors and Principals (CVCP)). Accordingly the Working Party at the outset explained its task to the UGC (whose chairman as a member of the ABRC was of course aware of the study from its inception) and to the CVCP to let them know what was in train and to acknowledge our recognition of their own spheres of influence. We had the advantage of discussing these matters with the CVCP, which is actively investigating the same range of issues, having appointed a Special Committee on the relationships between the universities and industry.

11. The recent decline in real terms in the public funding of scientific research in both the Research Councils and the universities, and its projected continuation, has concentrated minds wonderfully upon the ways of increasing income from other sources. Moreover incentives for making such an effort have recently been increased by the government decision to remove the monopoly of first refusal of patents and licences resulting from research funded by the Research Councils, until now held by British Technology Group (BTG) and allow individual scientists and their institutions (Research Councils and universities) to exploit such commercial possibilities. This is therefore a much investigated and much reported on topic. A ferment of activity is in progress, the results of which will not be known for some years. Some of the main reports which

the Working Party have used are mentioned at the appropriate points in the text but a more systematic list may be useful here:

Joint ACARD-ABRC Working Party (Muir Wood Report): *Improving research links between higher education and industry* (1983)

ABRC Working Party (Morris Report): *Support given by research councils for in-house and university research* (1983)

ACARD: *Industrial Innovation* (1978)

ABRC (Mason Report): *A study of commissioned research* (1983)

ABRC: *Scientific opportunities and the science budget* (1984)

CBI: *R and D—in recession too?* (1983)

Leverhulme Trust: Reports from the study on higher education in Britain made with the support of the Trust (1981–83)

UGC: *A strategy for higher education into the 1990s* (1984)

CVCP Working Party (Burnett Report): *The feasibility of alternative funding for the universities* (1984)

Conference of University Administrators: Report: *Boosting university income* (1984)

House of Lords Select Committee on Science and Technology: Reports on Engineering Research and Development (1982–3) and on Education and Training for New Technologies (1984–85)

First Report from the Education, Science and Arts Committee of the House of Commons: *The future of the science budget*, Vols 1 and 2 (HMSO 1985)

TUC: *The future business: Britain's research and development crisis* (1985)

12. These are the more substantial items thrown up by a great tide of activity, from the highest national level down to that of individual universities and Research Councils. The Prime Minister herself chaired a seminar on the subject in Lancaster House in September 1983; she and the Secretary of State for Education attended a seminar in All Souls College, Oxford in the Autumn of 1984. Seminars with senior industrialists were conducted by the Secretary of State for Education in the DES; and by the Minister of State for Industry in the DTI in July 1985. The CVCP's 'Universities and Industry' committee provides a forum for senior industrialists, bankers and vice-chancellors. The British Association, led by its President Sir Hans Kornberg, made the problems of funding scientific research a leading theme of its Glasgow conference in 1985. Equivalently resonant statements have been made by the Royal Society and the ABRC itself. Many of the views expressed to us by industrialists reinforced their evidence to the Committees of the House of Lords and House of Commons and representations to Ministers at the various seminars. As our own report was nearing completion we heard of the establishment of the Council for Higher Education and Industry to promote collaboration between the academic community and the business world. The House of Lords Select Committee on Science and Technology has also just launched an enquiry which includes in its terms of reference the organisation and funding of research and development in the UK.

13. In short there has been no lack of public, well-advertised discussion. This may, in the eyes of some, make our report just another journey along a much travelled road. However, the importance of the subject makes a new and widely-ranging survey of the field justifiable in present circumstances—circumstances which the Working Party believe will prevail at least for some years. The ABRC has reported that published government estimates for future public expenditure are such that the real 'science purchasing power' of the civil science vote will decline by at least 2% per year—perhaps much more—under realistic assumptions of rates of inflation of science costs, rates of increase of salary costs, redundancy payments and the like. The Chairman of the UGC has warned universities that they, too, must expect an annual decline in the real value of the UGC grant by 2% over the next few years. He has added that such economies are likely to affect the universities' research effort more than proportionately (because more immediately inescapable commitments will receive priority) unless special steps are taken. The evidence to this effect has recently been accepted by the House of Commons Education, Science and Arts Committee in its report cited above in paragraph 11.

14. This study of the prevailing facts about the private funding of research in the Research Councils and the universities and an assessment of prevailing opinion covers representatives of all the main parties involved in the provision and receipt of non-government funds for research. We have been concerned both with objective data and with perceived reality. We see our report as contributing to the debate from which, we hope, will emerge the formulation of a long-term integrated policy for the funding of scientific research in this country.

15. In this respect we quickly realised that the enquiry was not just a search to see what possible extra private funds could be substituted for existing public money. The picture is a complex one both in terms of the research needing funding and potential sources of funds (and modes of funding). The spectrum of research ranges from 'basic' or fundamental research, undertaken for the advancement of knowledge without anticipated commercial results, to shorter-range applied research developing new technologies and products from a laboratory to a production context. Nor is this spectrum a linear one: relationships within it vary greatly in different areas of research and technology. The spectrum of research demands a matching diversity in research funding. Articulating a total policy therefore demands identifying which sectors of this spectrum of research demand public funding, which can rely on industrial support, where more funds can be attracted (and what changes may be required to encourage this), where options exist, what ranges of research are potentially attractive for collaborative funding of different kinds. In short, a diversified context demands a highly articulated set of responses.

Part 2—The context

16. This report has been prepared in a context where a prevailing imperative of government policy has been to seek a progressive reduction in public expenditure. At the same time, the ABRC (to which this Working Party reports) has consistently tendered advice to the Secretary of State that the civil science budget should be defended and enhanced, on the argument that future technological prosperity (apart from the cultural and intrinsic importance of supporting scientific activity) rests upon the continuing commitment to fundamental research which that budget supports.

17. There is no agreed public philosophy to which this Working Party can appeal from which a definitive set of rules could be derived to provide a practical guide for the funding of scientific research. Indeterminacies abound in such a quest, and, in any case, this would demand another sort of enquiry with new terms of reference.

18. No particular figure has absolute validity as to how much a nation 'ought' to spend on its research and development, or how the total sum should best be divided between in-house, government and industrial spending, and the funding of research in institutions of higher education and the Research Councils. There is also no agreed relationship between the amount spent on fundamental research in a country and the future pay-off in wealth-creating consequences. Correlations between the levels of spending on fundamental research and technological advance have varied greatly over time and between countries and a lively debate (historical and contemporary) continues about the complex relationships between the growth of scientific knowledge and the advance of technology.

19. These doubts may be focussed by imagining an extreme position. In a crisis of public spending, if all public investment in a major area of scientific research in this country were to be totally withdrawn, what would be the actual consequences *ex post facto* (as distinct from the declarations of interest and the predictions of all parties *ex ante*)? Would there be rescue financed by private funding in such an emergency, and, if so, to what extent and for how long? In the longer term, how would the adverse consequences of such a tragedy work themselves out? The answers to these and other questions doubtless depend much upon the actual field of scientific research in question.

20. As this report seeks to make clear we do not see private money as a direct potential substitute for public money in many fields of research. We see likely progress much more in complementarities of funding, in relating private to public funding (in many different ways) rather than in seeking just to change the position of some linear frontier between public and private responsibilities in funding research.

21. Despite prevailing debates about the relationships between fundamental research and industrial progress we are impressed by various contrasts now being revealed between the present position in the United Kingdom and that of other advanced industrial nations where comparisons have most relevance. These contrasts, in the two or three years since 1981, set the context in which the results of our enquiry have to be assessed. We are concerned both by the differences in levels of performance between the United Kingdom and other countries and by contrasts in current trends.

- i. In terms of total spending on civil R and D the United States, Germany and France spend a much higher proportion of their GDP than does the United Kingdom: 2–2.5% as against 1.6%. Given the greater size of their economies, this means that spending on civil R and D in the United States is running at seven times the level of that in the United Kingdom and in Japan at three times the United Kingdom level. Moreover total expenditure on R and D in Japan in recent years has been growing at 7% per annum; in the USA at over 4% per annum; in France and Germany growing slowly, but growing; but it has been actually declining in the United Kingdom. The United Kingdom is thus revealed as reducing its commitments to R and D at a time when its main economic competitors are increasing theirs.
- ii. The proportion of civil R and D funded by government in the United Kingdom (compared with defence R and D) has fallen and is projected to fall further. Over a third of total government R and D spending in industry goes to aerospace alone. British government R and D spending for industrial productivity is about half that of France and Germany. Defence R and D spending (principally development costs) now absorb 50% of total government R and D costs in the UK; a percentage which is projected to rise in the next years. This commitment to defence R and D is much higher than in all the main industrial economies except the USA—the EEC average is under 24% and the percentage in Japan is less than 3%.

- iii. Industry in Japan, Germany and the United States funds a substantially higher proportion of total R and D in these countries (60%, 60% and 50% respectively) while industry funds only 40% of total R and D expenditure in the United Kingdom. Moreover in 1981–83 R and D carried out by British industry declined in volume by 6%.

22. We acknowledge that there is a long tradition in the United Kingdom of public funding of basic research, that there are deep-seated expectations about the relationships between public and private responsibilities (couched in what is considered equitable and what 'fair' levels of taxation are). It is apparent from the data in Annex C that twice as much basic research is being funded from public sources as from private funds (this excludes the university contribution as no split is made in the statistics available to us as between university funding of basic research, applied research and development), whereas less than a quarter of applied research and less than 10% of development costs come from public funding (defence expenditure excluded). Such levels of expectations are difficult to change, in the short-run at least, and are bound-up with wider public philosophies about the role of government. We also acknowledge that the recent depression doubtless had an impact upon research spending by British industry. International comparisons are not without their own problems of interpretation and the exact comparability of data. However, despite all such reservations, the basic differences revealed by the contrasts between the United Kingdom and our main industrial competitors do raise most important questions which we have had in mind during this enquiry. The latest assessment of the international comparisons contained in the Annual Review of Government Funded R and D for 1985 confirms these trends and reinforces our disquiet.

23. We think it desirable briefly to set this study in context by quantifying the scale of R and D funding carried out by Government, industry and other sources. The information set out below and in the associated annexes (A–H) has been obtained from material which has appeared in the Annual Review of Government funded R and D, the DTI Business Monitor series, Economic Trends or British Business. We are grateful to DTI, HMSO and to the editor of British Business for permission to make use of this material.

Table 1: R and D funding by sectors in 1972–81 (at current prices (£m) and %)

Funding Source	£m				%			
	1972	1975	1978	1981	1972	1975	1978	1981
Government*	640	1,117	1,651	2,826	48.7	51.9	47.0	47.7
Industry	571	877	1,552	2,529	43.5	40.8	44.2	42.7
Other	102	157	307	566	7.8	7.3	8.7	9.6
Total	1,313	2,151	3,510	5,921	100.0	100.0	100.0	100.0

*including defence R and D

Expressed in constant (1975) prices the totals given above are:

2,242	2,151	2,365	2,603
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Table 2: R and D performed by sectors (in current prices (£m))

Sector performing the work	1972	1975	1978	1981
By government	337	566	758	1,339
By higher education	115	179	317	630
By industry	831	1,340	2,324	3,792
By other sectors	30	66	111	160
Total	1,313	2,151	3,510	5,921

Total expenditure as a proportion of GDP at market prices:

1972	2.07%	1975	2.06%	1978	2.14%	1981	2.34%
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Note: Ministry of Defence net R and D expenditure: 1981–82 £1,745m, 1983–84 £1,984m. In each year this represented slightly less than 50% of total net government expenditure.

Table 3: Intramural R and D expenditure (£m) on certain industrial products in 1981 and 1983
(at current prices (£m))

	1981			1983		
	Total	Private Industry	Other Industry	Total	Private Industry	Other Industry
All industries	3,792.5	3,319.5	473.0	4,163.3	3,637.1	526.2
Manufacturing	3,511.7	3,205.2	306.5	3,869.9	3,513.7	356.2
Chemical (total)	617.4	609.9	7.5	735.0	726.9	8.1
Pharmaceutical products	296.1	295.8	0.3	377.7	377.3	0.4
Mechanical engineering	234.0	198.0	36.0	249.6	210.3	39.3
Electrical and electronic engineering	1,181.1	1,008.7	172.4	1,333.6	1,115.7	217.9

24. Government statistics have emphasised that this data has to be regarded as giving no more than a broad indication of the work done and the resources provided for it. The information in respect of government-funded R and D is, we understand, substantially comprehensive and reliable. That from private industry is less certain, deriving as it does from full surveys held only at four-yearly intervals with intervening sample surveys. We realise that there may be obstacles in the way of establishing a better data-base but we would hope that more information about R and D funded by industry could be elicited. Within the public sector we would also like to see steps taken to produce more reliable information about the amount of research funded in universities through the UGC recurrent grant.

25. The information obtained by DTI from the private sector does, however, enable certain generalisations to be made and we have been interested to see recent comments by ACARD and by DTI about the discernible trends. Chief among these is the indication that expenditure on R and D by UK private industry appears to be declining (Government R and D being itself comparatively static), it may be presumed in response to the squeeze of profits. We understand that the DTI sample survey in 1983 of the 75 enterprises which spend 80% of the total private sector R and D bill indicate that between 1981 and 1983 such expenditure adjusted for inflation fell by 6% in volume terms. Suggestions have also been made that a higher proportion of the research financed by British-based multi-national companies is being carried out abroad. The overall figures, of course, hide some contrasts: R and D in the chemical industry and in electronics rose whereas that in mechanical engineering and aerospace fell. It is not within the terms of reference of this Working Party to venture into a wider discussion about the national R and D effort and how it compares with that of our trading partners. Here we would simply note that, if private industry—by far the most important source of non-government funding of research—is cutting back on its expenditure on R and D, this does not make for a very buoyant or favourable climate in which public-sector institutions might seek substantially greater private funding of their research. Figures for the years 1983–85 now available suggest that the real decline in R and D funding by industry may be part of a longer-term trend rather than just a cyclical phenomenon, induced by the pressures to cut costs during recent years of depression.

Part 3—The present situation

A. THE RESEARCH INSTITUTIONS

26. In this section we offer a summary of what we have been able to find out about the current state of private funding of research. We look in turn first at the four main groups of bodies which carry out research and which come within our remit (excluding private industry), viz the Research Councils, the universities, the non-university higher education establishments and the research associations. We then attempt a comparable summary in respect of the 3 main groups of providers of non-Exchequer funding, viz industry, the venture capital interests in the city and the charitable foundations.

27. In this study we have not been concerned with the research carried out in (or, except in broad outline, with the funds provided for) the research laboratories of government departments or other publicly funded laboratories such as the UK Atomic Energy Authority (UKAEA) at Harwell. Nor have we been concerned in any detailed way with the flow of funds from government departments for commissioned research. We have however taken general note of the nature and extent of government research and funding as part of our contextual material and in this connection we should express our thanks to Mr O Roith, Chief Engineer and Scientist at DTI who, with two of his colleagues, gave us some very helpful comments on the place of Government in the research scene.

28. In this part of the report, which is concerned with existing facts and prevailing opinions, we have tried to avoid reaching conclusions or anticipating our recommendations. Where possible conclusions are deferred until part 4 and recommendations to part 5 of the report.

THE RESEARCH COUNCILS

29. In 1985–86 the 5 Research Councils have received allocations from the Science Vote as follows:—

	£m
AFRC	50.3
ESRC	23.6
MRC	122.3
NERC	67.3
SERC	298.0

Other allocations: (British Museum (Natural History), Fellowship of Engineering and Royal Society)
£22.35m

Total £583.9m

30. As part of their 1985 forward look submissions for the ABRC the Councils offered forecasts of receipts from non-science budget sources. These forecasts for four years are set out in full at Annex I. For 1985–86 only the forecasts may be summarised as below:

Table 4:

£m	AFRC	ESRC	MRC	NERC	SERC
Commissioned by government departments	54.0	0.2	2.5	20.1	
Commissioned by industry	2.5		0.7	0.7	
Commissioned by other	0.4		2.0	4.1	
Public Sector Fees for Services, etc	0.2		0.9	1.4	6.7
Private Sector: Sale Of Produce	3.0				
Rents	0.7				
Miscellaneous	0.7	0.2	0.2	1.5	1.9
Totals	61.5	0.4	6.3	27.8	8.6
% of total budgets derived from non-government sources	6.5	0.3	2.3	6.6	0.6

Although receipts from non-government sources vary widely between the Research Councils, ranging from £7.3m in the case of AFRC to £0.2m for ESRC, in no case do such private receipts constitute a significant proportion of the total income of a Research Council and their forward projections do not anticipate any

important change in this position. These data do not reveal information about jointly funded projects because private funds in such joint projects do not appear as income in the accounts of Research Councils and we would like to see steps taken to provide more information about the income generated.

31. The Research Councils were invited by the Working Party to send in written submissions and to meet us for a discussion. From the written submissions and the discussions we understand the position of the individual Councils to be in summary as set out below:—

THE AFRC

32. The Council categorises its non-science budget income as follows:—

GRANTS: These range from arrangements by which bodies give small donations to institutes without any specified purpose or return, to more specific arrangements under which a sum of money, some apparatus and equipment, or a grant to support a research worker, is given unconditionally, with no more than a general understanding as to the work to be done. There is no overt or implied obligation on the part of the institute concerned; the arrangement is one of goodwill. The work with which the grant is associated must be broadly relevant to the aims and objectives of the institute in which it is carried out and the nature of the research in such cases is essentially the projected programme of the institute concerned.

SPONSORED RESEARCH: This covers arrangements by which, in return for payment or gift of materials or equipment, or the provision of staff salaries by an outside organisation, an institute undertakes to carry out particular work of interest to the sponsoring organisation. The sponsoring organisation would be consulted about, and be aware of, the programme of research but would have no right of control; this would be at the discretion of the institute concerned. The sponsor would have no exclusive access to results, which would be communicated freely to all interested bodies, and usually published. In suitable circumstances the sponsor may have access to the results for a period of up to, say, 6 months before their general communication or publication. An essential criterion would be that the work carried out forms part of the legitimate programme of the institute, the external finance is accepted in furtherance of that programme, which is determined by the institute.

CONTRACT RESEARCH: Contract research is research in which the institute undertakes to carry out a specific programme of work, with accountability to the outside organisation, in return for a cash consideration. The contract will normally include clauses specifying the nature of the work and the end-point, and may give privileges with regard to oversight and control, and preferential access to results, at least for a specified period. Confidentiality may feature in the contract, and special provisions will be made regarding the rights in any patents arising from the contracted research.

33. During the financial year 1985/86 AFRC Institutes estimate that the 80 or so amounts in one or more of the above categories that they expect to receive from private bodies will be in total about £2.3m of which about £127k may come from charitable foundations. The difference of £200k between this total and the figure quoted in the table above represents income which is likely to arise from contracts currently being negotiated or likely to develop during the year.

34. AFRC commented in its written submission that, while the level of income from grants and sponsored research varied from year to year, the general trend was upwards. Contract work was an expanding area of activity and past figures showed that this income had doubled since 1978–79. The Council anticipates receipts of £7m from research commissioned by industry in 1988–89, a rise from £2.5m in 1985–86.

35. In their subsequent discussion with members of the Working Party AFRC officers said that the Ministry of Agriculture, Fisheries and Food (MAFF) (whose commissions constituted the major part of the Council's income) had been acting as a proxy customer for industry so far as applied research was concerned. The current situation in agricultural research was in a state of flux owing to the MAFF cutbacks, with the representative organisations of the agricultural industry in something of a defensive posture, maintaining that the field of research should be determined by those who paid (if a levy on the industry was in prospect) with the government continuing to fund pure research. Any research funded by a levy on producers was therefore likely to be short-term applied research of direct benefit to the industry.

36. On the food aspects of the Council's work we were told that this industry was not primarily a technology-based one but that it funded a significant amount of research through food research associations. Most of the Council's food research was, however, not of a kind that the industry could be expected to support.

37. So far as attracting private funding was concerned AFRC saw the essential point of contact as being between the institutes (which was where their expertise lay) and the industry, rather than through a central initiative. The Agricultural Genetics Company (AGC) was unusual in the venture capital field as it was pre-

pared to fund new research projects. Generally AFRC chose to deal with companies which had a technical commitment to the project which went beyond simply putting up the money.

38. A particular issue concerned the Plant Breeding Institute (PBI) at Cambridge. Considerable commercial income resulted from the large-scale sale of improved varieties of seeds developed by the Institute (more than sufficient, we were told, to pay the entire costs of running the Institute). However, all such income was received by Treasury through the agency of the National Seed Development Organisation (NSDO), which had the monopoly of sales. This was excluded from the recent legislation, which was limited to the monopoly rights of BTG. The Plant Breeding Institute raises the issue of potential privatisation (see paragraphs 82–88).

ESRC

39. In its submission to us the Council stated that a number of points distinguished the ESRC and also the social sciences generally from other areas of research with respect to attracting funds from the private sector.

- i. ESRC no longer had any establishments of its own, the 4 research units having been converted to Designated Research Centres (DRCs) secured within their host universities and with staff employed by the university. The Council was therefore no longer in a position to undertake commissioned research directly.
- ii. The output of social science was often of greater relevance to the public than to the private sector. ESRC was acting as contractor for a number of government departments which included: Trade and Industry, Environment and the Lord Chancellor's Department, but the Council's preferred mode of working with departments was that of joint funding. With this arrangement the departmental funding did not come to the ESRC as a receipt but went direct to the institution conducting the research. Examples of joint funding included:

Macro-economic Modelling Consortium with the Treasury and Bank of England;

Northern Ireland Economic Research Centre with the Northern Ireland Office (this Centre also had private sector funding from BP, Guinness, Marks and Spencer, Northern Ireland Bankers Association, Shell UK and others);

Health and Behavioural Change Unit with the Scottish Home and Health Department and the Scottish Health Education Group.

- iii. Once having established a strong research team or a DRC or launched an independent Centre ESRC expected that they would seek successfully for contract funding. The Council sometimes set a target for the level of such funding, sometimes to avoid a Centre becoming over-involved with short-term contract work. These Centres often attracted more funds from the public than the private sector but frequently from overseas governments and international agencies. The Centres not infrequently had 'club' funding arrangements where members of the club paid an annual contribution to receive publications, attend seminars and had a call on the expertise of the Centre.
- iv. With some of the activities supported by Council there was a strong expectation or, in some cases, even a requirement that outside revenue should be sought, leading to a position of self-financing. Examples of this were: the major macro-economic models which sell forecasting and other services and which plough back part of the money earned into the research; the Data Archive which will soon establish a commercial arm; the Macro-economic Modelling Bureau which is expected to do the same to make all the major models accessible to non-academic users (academic users have free access); the Economics Computing Centre.
- v. The Council also had a number of joint funding arrangements with the private foundations, principally Rowntree, Nuffield, Leverhulme and Esmé Fairbairn.

40. The Council emphasised to us that the preference for joint funding arrangements was logical as it allowed the complementary interests of a Research Council and a research customer to be satisfied within a programme of research. The Council sought to ensure that the standard of research was good and that the basic underpinning for the policy orientated research was satisfactory.

41. ESRC considered that the customer should therefore get a better piece of work which could be replicated and possibly extended without difficulty. Joint funding also implied joint input into the design and management of the research. The Council emphasised that it was difficult to give any accurate assessment of the total of private funding going into Centres which it supported but an estimate of £370K for 1985/86 was made.

42. The Council also mentioned to us the 'Open Door Scheme' which provides a research consultancy for all sides of industry and results in additional expenditure on social science research. The Council now also took part in the Teaching Company Scheme, its contribution of £120K raising £192K from the private sector.

In conclusion ESRC told us that it expected the level of outside funding to increase over the next few years and had particularly high hopes of a new information and communications technologies network, where encouraging meetings have already been held with representatives of private companies, including Granada Group, British Aerospace, IBM, ICI, Thorn EMI and British Telecom.

MRC

43. In its written and oral evidence the Council stated that it had a wide variety of arrangements for earning income from commercial and industrial sources. These ranged from straightforward research contracts, through collaborative and 'know-how' agreements to royalty income arising from marketed inventions. The Council's well-known relationship with the UK biotechnology company, Celltech,* provided several examples of these arrangements. Donations pure and simple were almost unknown to MRC so far as commercial and industrial sources were concerned. The more usual development was that an MRC team and a commercial company discovered they had a mutual interest in some problem and the company might then provide the chemicals or materials or might fund extra staff.

44. The Council emphasised to us that it was already alert to the possibility of generating further income from commercial and industrial sources, but stressed that it was Council policy that income-generation should not deflect MRC-supported teams from the directions and objectives which earned them the Council's support in the first place. The generation of income had to remain a subordinate, not a dominant, purpose of the MRC's research programmes. The Council added that the potential of an activity to generate income was no guide to its scientific priority or long-term value in extending human knowledge. Finally, the Council's policy for technology transfer, from which many of the income-earning arrangements arose, was dedicated so far as practicable to assisting UK industry. Foreign companies were often more potentially receptive, however, which made the slow responsiveness of some British companies disappointing.

45. Like the other Councils MRC laid much emphasis on the importance of not penalising success in earning private income by reduction of grant-in-aid. Even so it was accepted that some ceiling on retention of generated income had to be agreed, with some eventual return to the Exchequer from any major money-spinner.

46. In regard to purely private donations, such as bequests, the Council was empowered to accept benefactions, including trusts, but it did not appeal for benefactions in competition with the charities. As a matter of principle MRC used private benefactors to augment and not to relieve public funds and they were applied solely to the cost of research work without deduction of administrative overheads. The Council told us that it had used private funds to supplement the grant-in-aid in the past 7 years as follows:

	£K
1978-79	22
1979-80	307
1980-81	566
1981-82	87
1982-83	138
1983-84	920
1984-85	600 (estimated)

The Council's policy, we were told, was to keep a floor of £2m to generate sufficient income to allow further expenditure in support of the grant-in-aid in future years.

47. In its evidence to us MRC laid much emphasis on the complementary role of the major medical charities, the presence of which in medical research constituted a 'second force' not met with in any of the fields of work covered by the other Research Councils. The work of the medical charities is described in the next section of this report (paragraphs 241-256). In this part we would simply summarize MRC's view which was that:—

- i. the charities were, rightly, robust guardians of their autonomy and did business with MRC as equals.
- ii. although MRC and the charities tried to make their activities complementary this did not mean that one party was left to fund the other's lesser objectives: the common objective was to secure judicious use of available resources.
- iii. the charities sought funds and disbursed them on the understanding that their provision would increase the volume of medical research and would not reduce the input from central government.
- iv. it was exceptional for MRC and a charity both to support the same team or individual but successful collaboration had occurred where a joint effort was required, as in the support by MRC and the Cancer

* In this scheme this Council has a collaborating agreement with Celltech Ltd in the areas of genetic manipulation and monoclonal antibodies. A substantial part of the royalties payable by Celltech to the MRC is credited to a special MRC fund to finance additional biomedical research.

Research Campaign for the Institute of Cancer Research, the programme of research on neutron therapy on Merseyside and the tripartite funding of the Centre of Reproductive Biology at Edinburgh Royal Infirmary.

v. MRC directors and scientists were normally discouraged from seeking funds from the charities.

48. MRC concluded its written evidence to us by expressing the view that relatively little needed to be done or could be done to attract more private sector funds within what was regarded as the conventional province of the Council. What was needed was protection of the Science Budget and, within it, restoration to its former level (in real terms) of the Council's allocation from the Science Vote.

49. That said, the very real need for private sector funding lay in the region just beyond MRC's natural borders where ideas and laboratory inventions could be scaled up, developed and tested for practical and commercial exploitation. In this connection MRC is intending to set up a centre adjoining the National Institute for Medical Research where collaboration between MRC and university staff and research workers from industry can be encouraged. Some pump-priming (£1–2m) will be needed initially; thereafter the centre is intended to be self-financing. MRC told us that the project had aroused much interest and (with other proposals) had prompted enquiries from venture capital companies which suggested that there appeared to be no shortage of funds for projects with recognisable commercial relevance. The problem seemed to lie first in bringing ideas 'to the shop window', a function which MRC saw as its responsibility and second, in persuading industry to take them up.

50. The Working Party was interested to learn in subsequent discussions with MRC officers that the Council had set up a small headquarters unit to liaise with MRC unit staff in generating awareness of any potential for commercial exploitation, building up contracts with industry and advising inventors on the business aspects of agreements. This development might prove of interest to the other Councils.

NERC

51. NERC sees little chance of funding its pure research from private sources or in encouraging more unencumbered goodwill donations to augment the Council's funds. Similarly the Council sees no scope for regarding the charitable foundations as a source of funds for pure research; their activities are not seen as appropriate for this purpose in the environmental sciences. The main possibility in terms of private funding for basic research would (so far as NERC is concerned) lie in the model offered by the BP Venture Research Unit (see paragraph 200). As a quid pro quo a Council would probably have to offer the investor the rights to the intellectual property resulting from the work, at least for a period, and the Council would thus have to weigh up the advantage of obtaining funds for the work against the disadvantage of surrendering the property rights. Possible sources of finance for collaborative funding schemes of this kind would range from large commercial companies to merchant banks, venture capital organisations and the major clearing banks.

52. The Council regarded commercial activities as its main potential generator of private funds and explained to us that this objective inspired a deliberate impetus to the Council's marketing activities three years ago. The generation of income from private commercial sources we were told, has two sources. The first, and in many ways the easiest for NERC, is to undertake contract work in the private sector and for the agencies of overseas governments. This is seen as being an extension of the Rothschild commissioned research system to a new type of customer in which the Treasury demands that the charge for services should be 'at least full economic cost plus what the market will bear'. The Council has been trying to gauge this profit level more precisely and has been making major efforts to represent the relevance of NERC expertise and facilities, with such major assets as the ocean-going research vessels, to private sector customers such as consultants, mineral and other resource companies and survey organisations here and abroad. The Council has also directed its marketing strategy towards major funding agencies such as the World Bank, the Asia Development Bank and the European Development Fund (EDF). At present most of its customers are overseas government agencies.

53. In Europe the Council has a member of its own staff and an office in Brussels. He also represents the interests of nine universities who have subscribed to a 'club' for the purpose. The Brussels office explores opportunities in new research ventures and pursues the Council's own programming submissions to the European Commission. The office also actively pursues development work funded by the EDF and co-ordinates bids in the tendering exercises involved. The Council has also appointed an agent in Washington whose remit is to generate information on World Bank projects and to cultivate suitable contracts for the Council in relevant organisations. The Council is considering making a similar appointment in Manila, in relation to the Asian Development Bank. We commend these initiatives and suggest that other Councils might consider whether they have similar opportunities open to them.

54. Although the Council has yet to win a really large overseas contract it is recognised as a presence in the market place and increasingly companies seek NERC co-operation in mounting bids for overseas work.

The Council acknowledges, however, that this is a competitive area in which to operate and a Research Council is not always the most flexible body for acting commercially in overseas markets. It will be important to assess the results of these initiatives over the next few years.

55. In the past years NERC, like the other Councils, has paid much attention to the question of commercial exploitation. Successful exploitation of a key piece of technology can, under the right arrangements, generate a useful income. The Council has therefore been seeking to take advantage of being released from the BTG monopoly of the rights of exploitation of patents and licences by enlivening the interest of its staff in the potential of commercial exploitation and has had discussions with private sector companies concerned with technology transfer. The Council is exploring possible 'framework' agreements of the kind already in being with MRC and Celltech and AFRC and AGC and is examining the possibility of some type of NERC company that would operate commercially in this sector, perhaps with city financing. The intention was to produce a business plan later in 1985 for such a company which would include both exploitation and involvement in private-sector contract work in its activities.

56. At present NERC's income from commissioned research from private customers is between £4m and £5m. In the Council's view how this will develop must depend on how NERC is able to respond to market opportunities given the constraints of public accounting, Civil Service type regulations and conditions of staff employment, and the Council's policy criterion of engaging only in good quality science. The Council thinks that a separate NERC company might prove a means of avoiding such difficulties. It has been estimated that the potential market in NERC's areas of interest, assuming freedom from existing constraints, might turn out to be at least five times greater than the Council's present earnings. The Council accepts that the revenue to be gained from commercial exploitation is unpredictable and has in the past been small but it believes that there is now much more incentive to pursue the possibilities and that a useful, if modest, income should result.

SERC

57. In its oral evidence to us the Council representatives said that SERC was different from the other Councils in that the primary purpose of its research establishments was to support universities. Their large facilities were available for up to 10% of operating time (in addition to any spare capacity) for use by industry but firms seemed reluctant to pay. The Council had little in the way of unencumbered donations from private sources. After taking account of non-research linked receipts and conventional repayment work the majority of the Council's research-linked receipts arose from within the Science Vote and from the big public commissioners of research, particularly DTI. Some receipts could arise from other public and private sector sources; examples included:—

- i. contributions to the Council's energy programmes from the National Coal Board, British Gas and Central Electricity Generating Board. These took the form of a percentage contribution to research grants expenditure on work of mutual interest, and did not necessarily feature in the SERC accounts as income;
- ii. the Council's Biotechnology Directorate's jointly funded programme in protein engineering. The arrangement entailed six companies contributing annual sums for up to four years with SERC funding the balance.
- iii. a limited amount of other research which was akin to commissioned research.

58. In regard to the biotechnology development (57.ii. above) the Council explained that this could be seen as something in the nature of a 'club' arrangement. In return for their investment the participating companies received seats on the management committee and were able to keep up to date with developments in the field. They would also have exclusive initial access to research results but would not own the intellectual property rights. The Council emphasised that this venture had taken much effort to set up, with only a relatively small input coming from industry. It was a scheme which could only be used in the pre-commercial phases of research in an industry like biotechnology where the time horizon between pure research and commercial exploitation was relatively short, and where a relatively small potential club of large firms existed. The Council was uncertain that significantly increased funding could be generated in this way in other fields of research.

59. SERC also told us about its receipts from foreign national scientific organisations which had become involved in research using the Council's central research facilities. International organisations with which the Council was involved also generated income; examples included contracts with the Centre Européen des Recherches Nucléaires (CERN) and an ECC sponsored research programme. The search for international participation in SERC facilities (such as the Rutherford Appleton Laboratory's Central Laser Facility and the Synchrotron Radiation Source at the Daresbury Laboratory) would be intensified.

60. It was explained to the Working Party that the Council had developed co-funding projects as had other Research Councils, ie which did not result in receipts appearing in the Council's accounts but which nonetheless represented valuable contributions to the Council's overall programmes and extended the volume of research produced by a given quantity of public money. Examples given to us included the Co-operative Research Grants Scheme; the Council's Teaching Company Schemes and the Co-operative Awards in Science and Engineering (CASE) scheme.

61. The Council summarized its evidence by saying that, at present, it received a limited amount of income from private sector sources (about £0.5m) all of which was tied to particular research objectives but that, as outlined above, there were other larger ways in which the programmes financed by the Science Vote benefited from co-operation with the private sector even though the Council received no money from them. The trend was for an increase in private sector receipts but it was expected that such income would continue to be directly linked to particular activities and there was little prospect of significant income in the form of donations without strings, or for research unconnected with a direct commercial objective.

62. SERC summarised for us its 1983–84 estimated receipts in the following way:—

Non-research linked receipts	£2.37m
Research linked receipts	
i. other Government Departments and Science Budget	3.94
ii. other public corporations	0.54
iii. private sector/industry	0.49
iv. overseas	2.65

PARTICULAR COLLABORATIVE SCHEMES

63. The Working Party considers that it may be helpful at this point in the report to note three examples of collaborative schemes which may offer pointers to future developments.

THE ALVEY PROGRAMME

64. This initiative was launched in 1983 following the report of the Alvey Committee which had been asked to advise on the scope for collaborative research in information technology in the light of increasing overseas competition. The report recommended a 5 year programme costing £350m involving collaboration between industry, the academic world, central Government and the SERC. The Government allocated £200m for the project on the assumption that the remaining £150m would be found by industry. The programme is managed by a directorate located at DTI but representative of all the parties involved. The programme breaks new ground in a number of ways: its co-operative character is one unusual feature but it is also not primarily responsive to a pre-existing demand, being a directed programme based on a pre-defined strategy produced as a result of extensive consultation and discussion with industry and the academic world.

65. The work is being carried out in consortia of firms, academic teams and research establishments, a typical consortium including two or three firms and one or two universities. Much of the academic work is concentrated in a few centres of excellence where multi-disciplinary teams from different departments in those universities can be brought together to work on the Alvey projects. In addition there are a number of academic projects of a long range or speculative nature in which close industrial participation would be at the present stage inappropriate. Such projects have industrial members, however, to advise on industrial aspects and the timing for full industrial participation. In all parts of the programme 'clubs' are being set up to bring participants together and to act as an information exchange.

66. The Alvey scheme has pioneered, for information technology, an important means of bringing Research Councils, universities, polytechnics, government departments and industry together. It serves as a model which could usefully be extended and applied in other areas of research.

'CASE' AWARDS

67. SERC Co-operative Awards in Science and Engineering (CASE) support research students working on projects of between one and three years duration. Such projects are jointly devised and supervised by academic departments and collaborating bodies drawn from industrial and commercial organisations in the public and private sectors, local authorities and Research Council institutes. The scheme covers the whole field of science and technology and the projects, though normally research-orientated, allow for a variety of work including studies in design and manufacturing problems.

68. Under the scheme collaborating bodies may make payments to the student without abatement of his basic SERC award. Tuition fees are paid by SERC.

69. SERC is prepared to waive any claims it has to an interest in the research results obtained provided that satisfactory terms can be agreed between the participants.

70. The scheme is well thought of throughout industry, affording as it does scope for industry and commerce to forge closer links with higher education and to draw upon the expertise and facilities offered by the latter.

THE TEACHING COMPANY SCHEME

71. This scheme was set up in 1976. It is supported jointly by DTI and by SERC and aims to develop active partnerships between higher education and industry (principally in manufacturing) in order to raise industrial performance by effective use of academic knowledge and capacity; improve manufacturing and industrial methods by the effective implementation of advanced technology; train able graduates for careers in industry; develop and retain existing company and academic staff; and give academic staff broad and direct associations with industry for research and as a background for teaching.

72. The scheme operates through Teaching Company programmes in which a university or polytechnic participates in a company programme to achieve a substantial and comprehensive enhancement. The permanent academic staff involved are assisted by graduates of high quality recruited in consultation with the company for two year appointments as associates.

73. SERC and DTI make a grant through the scheme towards the basic salaries of the associates and academic support cost. Further support may also be available under the scheme and through other DTI and SERC channels.

74. The scheme has won wide acceptance since its inception and now has more than 120 programmes in operation, involving over 50 academic institutions. The ESRC is now participating in the scheme.

THE RESEARCH COUNCILS—CONCLUSIONS

75. The general impression we have gained from speaking to industry and commerce and to the Councils themselves is that, while each of the Councils can point to some useful individual achievements in the field of collaboration with the private sector, taken as a whole the Councils have fewer close ties with industry and commerce than might have been expected. Further we have formed the distinct impression, as we record in our remarks about industry, that the business world has considerably greater reservations about the scope for—and the advantages of—developing collaborative funding schemes with the Councils (as opposed to the universities) in present conditions. The issue therefore is: given the value of collaboration, what conditions need to be changed if it is to be increased?

76. Clearly some parts of the overall Research Councils' efforts are well-known and respected. We particularly have in mind the various collaborative schemes involving SERC and certain of the individual initiatives of the other Councils. But the impression given us by industry and the venture capital interests is that the Councils are perceived as being somewhat remote from commercial needs, with a present organisational structure doubtfully relevant to the requirements of industry.

77. It was put to us more than once that companies might be prepared to collaborate with a Council or, more probably, collaborate in a tripartite scheme with a Council and a university but that the company concerned would be unwilling to channel funds directly to the Council. Processing funding through the Council was seen as undesirable, if only by adding an unnecessary tier of administration to what should be a straightforward industry/university nexus, and the Councils were seen as having instead a potential role as brokers or catalysts. The importance of such a 'triple alliance' between industry, the Research Councils and universities/polytechnics is stressed elsewhere in this report.

78. Many of the funding options open to academic institutions hardly exist for the Research Councils. Councils have little or no opportunities to attract much in the way of significant extra funds from alumni, general-fund raising appeals, renting out facilities or accommodation or of attracting private funding for particular staff posts and no realistic prospects of fund-raising through such academic mechanisms as student fees or continuation courses. Science parks were rarely mentioned in the Research Council context and we are doubtful whether the Councils have much scope for either developing funding opportunities through the existing parks or for striking out and creating parks of their own.

79. We consider that the Councils should investigate, in consultation with industry, ways of increasing their flexibility and effectiveness in negotiating with private companies and, in particular, we suggest that Councils should examine the possibility of promoting corporate forms of organisations to provide appropriate vehicles for exploiting research, for developing their relationships with industrial firms and for possible joint participation by venture capital interests. We have elsewhere in this report noted the encouraging develop-

ment of the 'club' concept and we would like to see the Councils taking this idea further so as to facilitate the subscription by private firms to potential developments in their formative stage. We add that we would like to see the Councils (and the universities) exploring the opportunities for extending the range of joint funding of research into industry beyond short-term applied research into 'strategic' research, wherever the field of science makes this possible.

80. We wish to stress that there can be no guarantee that any measures adopted by Councils to seek more private money would bring in significant extra funds. Some, especially in the international field, might do so in time but we would expect that the main benefits would lie in the form of modest inflows of funds together with an increase in mutually beneficial non-monetary contacts with industry and commerce that might, in the longer run, lead to collaborative developments of some financial benefit to the Councils. It is not necessarily the case, of course, that the utility of the Councils in supporting British industry is to be measured by the income which they derive directly from industrial collaboration.

81. We do not wish to imply that the Councils should go all out for commercial funding, regardless of Council policies in relation to fundamental research. We entirely accept that Councils have a responsibility to pursue high quality basic research—a point emphasised to us by more than one of the Councils in evidence to us (and by industrialists as well) and that they would be reluctant to embark on commercial ventures that might of necessity involve departures from Council standards or the diversion of staff and other resources away from important basic research functions, or their own assessment of priorities in research. In our view it is for each Council to decide how far it wishes to go down the private funding route.

PRIVATISATION OF COUNCIL UNITS OR ACTIVITIES

82. We noted earlier in this report that we had been asked to consider what scope there might be for transferring some parts of the Research Council system to private ownership. As we understand it this suggestion derived from two sources, one general, the other specific. The general source is, we assume, the Government's commitment to reducing the size of the public sector by transferring to private ownership those parts of it which seem inappropriate to public funding and control and which can lead a successful life in the private sector. The specific origin is presumably the comments contained in the 1983 report produced by Sir Ronald Mason FRS for the ABRC on the subject of commissioned research in relation to the bodies funded through the science vote.

83. In his report Sir Ronald considered that the present structures and commitments of the Research Councils owed more to the accretions of history than to any rational calculus of the scientific opportunities and possible developments that lay ahead. With particular reference to the AFRC and NERC Sir Ronald argued that those two Councils must have concern for their predominant investment in institutional research and he went on to say that a number of their institutes had, he felt, a clear need for re-orientation, amalgamation, privatisation or transfer to an appropriate government department.

84. The AFRC and NERC have of course both undertaken extensive restructuring programmes, and more are in train, so that Sir Ronald's suggestions may no longer retain the force they originally had. The Working Party certainly agrees with him that privatisation would appear to have little application to the other three Councils. The ESRC now has no institutes of its own; the main commitments of MRC's institutes are not to research activities attractive to the private sector and SERC's small number of major institutes operating facilities would not seem to be candidates for hiving-off. It is essentially only institutes doing applied work with attractive commercial applications which would be candidates for privatisation and this sort of work is primarily within the terms of reference of AFRC and NERC. Nonetheless, when the Working Party met senior officers of the Research Councils we asked what their views were on privatisation. The point was specifically raised in discussion about AFRC whose representatives pointed out that the Soil Survey and the Plant Breeding Institute (PBI) were, in theory at any rate, possible candidates. They stressed, however, that in general AFRC would prefer to keep the whole spectrum of its research effort together, scattered as it was over a number of institutes, and it seemed preferable to keep the Council's research resource intact and to seek returns from royalties and the commercial exploitation of its research efforts. If, however, some parts of the Council's system had to be considered for selling off, candidates ought desirably to be sought from the applied end of the spectrum. Subsequently, whilst this report has been in preparation, there have been developments over the AFRC establishments mentioned.

85. We can see the force of the AFRC point of view and we doubt whether there is at present much scope for the hiving-off of Council activities but we suggest that those Councils with large numbers of units should give the possibilities due consideration in the development of their future restructuring or corporate plan strategies.

86. Privatisation carries with it a penalty for success which our terms of reference oblige us to acknowledge. The Research Councils are currently being encouraged to increase their income from private sources, as commissioned research from the ministries declines—a particular problem for NERC and AFRC, who also have

greater opportunities for private earning than other Research Councils. As this Report has sought to make clear, such increased private income is to be expected from applied research, close to or within the commercial context, rather than from long-term basic research. If a Research Council institute is so successful in this regard that it attracts commercial offers, privatisation will cut-off the flow of private income from research contracts which its applied research potentially brought in, unless means were to be found for maintaining a stake in the enterprise when privatised. A succession of such sales would clearly reduce the private earning capacity of the Research Council concerned and thus defeat the policy of increasing that capacity. Surviving institutes with less applied work would attract less contract income. The Research Council would become more concentrated on basic research; more fully dependant on public funding.

87. Apart from the loss of future earning power there is also the question of whether a Research Council is able to keep the proceeds, in full or in what proportion, of assets thus privatised. Maintaining a stake in a privatised company (apart from a shareholding stake without continuing research links) also poses questions of potential conflicts of interest and accusations of preferential treatment.

88. The consequences of privatisation and the methods by which it is to be achieved need to be examined in each individual case. There is an important public interest to be safeguarded in maintaining the quality of research following privatisation, if the benefits of previous public investment are not to be lost, and general access to the results of research preserved.

89. These observations represent the consequences of privatisation in a 'static' situation. As Research Councils develop commitments in 'strategic research' areas in the future, then other options may apply. In such fields as biotechnology research developments are of great potential interest to industry and the relationships between basic research and commercial applications are dynamic. Advances in fundamental knowledge can throw-up research programmes for particular applications, embodied in units or groups which could be spun out at appropriate points in their evolution. This, conceived as a dynamic process, would not then lead to the cumulative impoverishment of the Research Council concerned.

THE POLYTECHNICS AND OTHER NON-UNIVERSITY INSTITUTIONS OF HIGHER EDUCATION

90. In considering the non-university institutions of higher education the Working Party has found itself in the difficulty evidently encountered by two other recent groups—the 1983 joint ACARD-ABRC working party on 'improving research links between higher education and industry' (the Muir Wood report) and the ABRC Working Party under Mr J R S Morris whose report on 'the support given by Research Councils for in-house and university research' was published in the same year. The Morris and Muir Wood Working Parties both had difficulty in finding out information about research activity in the polytechnics. Each came to the conclusion that the non-university institutions had relatively little fruitful contact with industry (Muir Wood) or the Research Councils (Morris) and both concluded that inadequate funding meant that the polytechnics and other local authority colleges often had a barely adequate base for research.

91. The Muir Wood report gave its view, first, that over-detailed control by local authorities and a lack of central provision for research support inhibited industry/polytechnic interaction and, secondly, that the research potential of polytechnics was inhibited by lack of any direct funding for research analogous to UGC research support of the universities. The Muir Wood Report argued, however, that the polytechnics needed to be encouraged to develop their research capability in a selective way, building on particular strengths, particularly in relation to local industry. The report also urged that an existing ambiguity about the legality of polytechnic work for industry and commerce needed to be removed.

92. The Morris report noted the research disadvantages suffered by local authority institutions and urged greater encouragement for them on the part of local and central government and the Research Councils whilst stressing, in terms similar to Muir Wood, the need for the polytechnics to avoid duplication of research done elsewhere. In the view of Morris non-university higher education should continue very largely to concentrate on applied rather than fundamental research.

93. Since those reports appeared there has been one notable development affecting non-university higher education. A recent Act of Parliament has removed the uncertainty relating to the establishment of commercial enterprises in polytechnics and the provision by the latter of services to industry and commerce. The Further Education Act 1985 makes it lawful for polytechnics and local authority colleges to sell on a fully commercial basis the by-products of their research and teaching, removes legal restrictions which previously hampered such colleges and clarifies the law relating to the numerous business side-lines already existing in local authority colleges as an adjunct to their main teaching functions. The Working Party welcomes this removal of the disability under which the polytechnics and colleges have laboured and which goes some way to placing them, at any rate in theory, on an equal footing with the universities. We hope that remaining institutional and practical constraints can also be removed.

94. The Working Party received two helpful pieces of evidence relating to non-university higher education, one from the National Advisory Body for Public Sector Higher Education (NAB), the other from the Committee of Directors of Polytechnics (CDP). The NAB submitted a copy of its discussion document on the funding of research activity together with a covering paper which stressed the potential importance of the polytechnics in the national research effort and identified the obstacles, already noted by the Muir Wood and Morris reports, in the way of developing a satisfactory research role in non-university higher education, which had been denied the benefits of the 'dual support' system enjoyed by universities. The NAB paper explained that, following the report of a research group (which had included in its membership the chairmen of both the SERC and ESRC), a fund had been established to encourage selective development of non-university research. A sum of £2.5m has been made available from its main grant for 1985–86 distributed to 21 institutions, the larger sums disbursed being in the range of £75–150k. This was intended as a first step.

95. The NAB submission offered some useful factual information in a field normally distinguished by a dearth of statistics. Not being independent chartered bodies (in contrast to universities and Research Councils) maintained colleges do not make available financial and other statistics of the kind met within university and Research Council publications and it has been extremely difficult to discover any reliable figures about the amount of private income reaching the polytechnics. To a large extent this lacuna still exists and we would like to see steps taken to remove it, but the NAB evidence has provided a useful indication of the extent of collaboration between non-university colleges and industry. A recent NAB survey has shown that 28 respondent colleges indicated that they were involved in collaborative research and consultancy with some 400 separate companies ranging from large multi-nationals to small local firms. On average each major institution had links with between 30 and 40 companies. Major 'household name' companies commonly each had collaborative research and consultancy links with more than half a dozen polytechnics. NAB have also pointed out to us that some 40% of the teaching companies (see paragraph 71 et seq) established by SERC are in non-university institutions.

96. Looking to the future NAB has been considering ways in which funding mechanisms might be used to enable institutions to respond more speedily and effectively to employment and general economic needs. A recent NAB group report noted that research and consultancy provided institutions with further opportunities to obtain external funds but commented that, despite some growth, obstacles still existed. The report identified some of the impediments as of a purely institutional kind (where, for example, local collaboration depended purely on one individual staff member without wider effective institutional support). Similarly financial constraints imposed hard choices upon colleges facing the dilemma of whether to divert hard-pressed income to provide the risk capital to establish a base from which external funds could be sought. The NAB research fund (see paragraph 94 above) is intended to remedy this deficiency but NAB is aware of the need to increase the size of this allocation greatly if it is to become fully effective.

97. The NAB also strongly commends the Muir Wood report's proposal for a 'seedcorn' fund under which Government would provide extra funds to higher education institutions in proportion to the private receipts attracted by the latter. In essence NAB's submission argues persuasively for greater funding, on a selective basis, for the non-university sector, given that the legal impediment mentioned above has now been removed.

98. In their submission the Committee of Directors of Polytechnics (CDP) acknowledged the lack of detailed information relating to private funds attracted to the polytechnics but suggested that in 1982–83 the value of current sponsored projects might amount in total to some £40m for all 35 polytechnics and their Scottish equivalents. This sum, however, is not a true 'private funding' figure because it includes monies from Research Councils and from Government.

99. CDP also offered the Working Party views similar to those submitted by NAB (and noted in the earlier Muir Wood and Morris reports) about the lack of an adequate funding base for research in the polytechnics. CDP saw, as did the Morris Report, that the absence of a 'dual support' system for research largely prevented the establishment of the 'well-found' laboratory and deprived the polytechnics of the chance to develop attractive research bases from which to seek external sources of additional funds.

100. CDP concluded by saying that they were not wholly convinced that the 1985 Act (paragraph 93 above) would fully achieve its stated objective of regularising the legal situation in relation to consultancies and other enterprises. In the CDP view this enabling legislation would remove legal obstacles but would not guarantee that polytechnics, as distinct from their local authorities, would be able to retain income earned from commercial activities. CDP evidently felt that the polytechnics would still be too fettered by the financial and administrative requirements of their maintaining authorities to be capable of the speedy responses necessary for success in the commercial world, a view close to that expressed by the Muir Wood Report in 1983. CDP are convinced that some form of corporate status for the polytechnics, with adequate safeguards, is the only practicable solution and would have preferred to see the 1985 Act confer on local authority colleges corporate status as limited companies.

THE NON UNIVERSITY SECTOR—CONCLUSIONS

101. In considering the polytechnics and other large colleges of higher and further education (which we have not considered in any detail) we have been impressed by the evident determination of the NAB to identify and to encourage promising centres for research in non-university higher education. It is evident that the non-university institutions have to date generally lacked the resources to develop a true research capability (at least any capability dependant upon extensive facilities) and to develop significant collaborative research links with industry and commerce. Again, there were some notable exceptions to this generalisation.

102. We welcome the legislative steps taken to remove from polytechnics the uncertainties about their legal capacity to sell their services but we note the feeling in the colleges that this may not in itself be sufficient and that further changes may be needed to ensure that the major colleges can operate freely and retain an effective proportion of income deriving from commercial initiatives. We do not think it would be appropriate for us to comment on the legislative possibilities: given that the new Act has only recently come into force, however, it would seem desirable to see how it operates in practice for a period of time before further changes are contemplated.

103. What the non-university institutions need, like the universities, is an assurance that their basic funding from central and local government is adequate to enable them to perform effectively both their teaching and research functions (which is not to maintain that their research roles should be identical). That is the most important consideration and the encouragement of non-exchequer money into the polytechnics is, we think, a subordinate objective. We would, however, like to see the Government give further consideration to the industrial 'seedcorn' fund proposal, set out in the 1983 Muir Wood report, as we think that this might well be the most effective way of developing profitable collaborative links between industry and non-university HFE.

104. We are unsure of the extent to which non-university institutions have attempted fund raising of the alumni appeal or general appeal types familiar to the universities but we consider that these devices would be worth consideration by at any rate the larger, older-established institutions. Such income is unlikely to fund research programmes or posts directly but it might sometimes allow new buildings to be erected or particular pieces of expensive equipment acquired.

THE RESEARCH ASSOCIATIONS

105. The Working Party is indebted to DTI for supplying information about the Research Associations and for arranging that individual associations should write to the secretariat about their work. We understand that there are currently about 60 of these organisations with a total turnover of about £200m per annum. Some are specialist 'monotechnic' associations devoted to the needs of particular industries or more specialist sub-branches of industry and performing a valuable function in promoting research for small or medium sized companies. The picture which emerges is that the Research Associations vary greatly in many ways but have a common purpose in essentially filling a separate role in applied research, mostly of a short-term developmental or testing nature, but that they are potentially in competition with the Research Councils and higher education for departmental and industrial funding and cannot themselves be regarded as a possible source of funds for the Councils and for the academic community. As government funding to the Research Associations declines so they become more dependent upon their earning power in contract research.

106. It has, however, to be noted that some of the larger Associations do have collaborative agreements with higher education. These can take various forms: examples include the following:—agreements with Cranfield (fluid engineering); sub-contracting work to the University of Bath (plasma deposition); and a joint programme with Brunel University in which SERC, DTI and private industry are also involved. Collaboration in Alvey projects has been mentioned and one or two of the Associations also say that they make fairly regular use of advanced instrumental facilities at certain universities and polytechnics and have sponsored individual postgraduate students. The Motor Industry Research Association has reported that it currently funds university research (unspecified) to about £15,000 per annum.

107. Where sums of money in connection with these activities have been disclosed they have usually been small (typically less than £5,000) and more than one of the Associations indicated to us that they at one time funded work with the Councils and in higher education but no longer do so because difficulties with their own funding have made it impossible to place significant amounts of sub-contract work. The assumption must be that the Research Associations have been adversely affected by the general recession. In any case the budgets, individual and collective, of the Research Associations, as well as the nature of their work, limit the potential for collaboration and research funding.

108. We do not pretend to have other than a limited picture of the extent of Research Association involvement with the public sector. Our overall impression however, is that the Associations have more dealings with universities than with Research Councils (SERC among the Councils appears to have by far the largest amount of collaborative involvement with Associations) and are understandably and rightly governed by commercial considerations in their approach to bodies which, as noted above, must be seen by them as largely competitor organisations in the field of commercial research. It should perhaps be noted in this connection that some feeling exists among the Associations that the universities offer unfair competition in contract research by not charging for overheads (either in whole or in part) and it was also put to us that some Associations regarded academic institutions as unbusinesslike in their approach. The indications from the letters sent to us through the good offices of DTI are that the Research Associations have less disposition now than they had in the 1960s and 1970s to collaborate with Research Councils or higher education and we see little scope for increasing substantially the flow of funds from the Associations to the public sector.

THE UNIVERSITIES

109. We noted in the introductory part of this report that we were conscious that the universities constituted a section of the research field in which the UGC and CVCP had responsibilities not shared by the ABRC. We were also fully aware that much work had already been done in individual universities on developing links with industry and commerce in order to increase income from non-Exchequer sources, and that great activity was in progress. We came to the conclusion at the beginning of our study that it would be wrong in principle and not feasible in practice for the Working Party to devise a programme of visits to universities or to attempt to mount an independent survey of their attitudes and objectives in relation to private funding. The CVCP is actively enquiring into the question so the Working Party accordingly decided to work through the CVCP and UGC, making use of the data those bodies could provide.

110. In the event approaching the university sector at one remove has not, we think, been to the detriment of the study. In the first place we have been able to make good use of three documents issued not long before our study began: the UGC document 'A Strategy for Higher Education into the 1990s'; the report of a working party of the CVCP under Dr John Burnett, Principal of the University of Edinburgh, on 'The Feasibility of Alternative Funding for the Universities'; and a report 'Boosting University Income' produced by the Conference of University Administrators (CUA). We think it useful to offer a brief comment on each document at this stage in this report.

A STRATEGY FOR HIGHER EDUCATION INTO THE 1990s

111. This UGC strategy document devoted one section to the discussion of alternative sources of funding. Until the Second World War, non-Exchequer income provided the greater part of universities' funding but the enormous expansion of the university system since 1945 (and more particularly since the early 1960s) made government funding on an entirely new scale essential. The UGC noted that in broad terms universities' recurrent income in 1982-83 derived from the following sources:—

	£m	% of total
Public funding		
UGC recurrent grant	1205	64
Home student fees etc	150	8
Research grants from Research Councils	114	6
Computer Board Grants	16	1
	1485	79
Other income		
Endowments, donations, etc	20	1
Services rendered (overseas student fees £83m; research grants (non Research Council) and contracts £145m; other items £79m)	307	16
Other sources	66	4
	393	21

112. The document went on to distinguish between two main types of 'other' income: donations, sometimes made without conditions although often directed towards some specific new development; secondly, payments for specific teaching or research. The UGC emphasised that it would like universities to increase their 'other' income and it welcomed the Burnett and CUA reports for their assistance in that direction. But the UGC went on to state with great conviction that it would be unwise for Government to imagine that there could be any major change in the balance of private and public university funding. In the view of the UGC Government had to continue to ensure a 'core' of public funding to provide the teaching and research which

were in the national interest and 'other' income could not be expected to remedy deficiencies in such 'core' funding. The Chairman of the UGC recently repeated these views to the Education Science and Arts Committee of the House of Commons.*

113. The remainder of this part of the UGC document is devoted to an examination, with specific recommendations, of the various aspects of private funding and we shall return to the points made therein later in our own report.

THE CVCP (BURNETT) REPORT

114. The Burnett Working Party was set up in 1983 to consider the possibility of attracting alternative funds to provide for the core activities of universities—teaching and basic research. The report was issued in July 1984.

115. In its report the Burnett Working Party noted a pronounced and continuing decline in the proportion and real value of endowments, donations and subscriptions (although it acknowledged that these were still of value and importance to individual universities) together with the increasing proportion of income deriving from research grants and contracts. Much of the recurrent income which (in 1982–83) could be regarded as non-governmental money was provided for specific purposes and only a small part of it could be classified as 'free' money.

116. The Burnett report went on to identify three possible ways of providing 'alternative' funding viz: substitution funding (ie the generation of sufficient private income to compensate universities for any decline in government funding); additional private funds to augment government funding; and alternative mechanisms to the present system of government funding.

117. The report identified four potential sources of alternative income: commercial activities, alumni and other benefactors, industry and commerce and students. The report considered these in turn and concluded that each offered a way forward in the generation of additional private funding but noted that any major development of at least two of these funding mechanisms would largely be outside the direct control of the universities themselves. Each source had its own advantages and limitations.

118. We return to the Burnett proposals in reaching our own conclusions later in this report.

THE REPORT OF THE CONFERENCE OF UNIVERSITY ADMINISTRATORS

119. This report was published in July 1984 as the recommendations of a CUA Working Party on supplementary sources of funding for universities in Great Britain. The report is in our view a useful conspectus of present practices and possibilities and a potentially helpful practical guide for use by universities in developing their fund-raising strategies. We touch on some of the points made by the CUA group later in our report.

THE UNIVERSITY SCENE—SOME GENERAL COMMENTS

120. What emerges most forcibly from the available material about the universities is the wide variety of mechanisms and modes of seeking non-exchequer funds, together with the great energy being currently devoted to enhancing income from private sources. For reasons already stated the Working Party has not been able to make a detailed study of university practices and we cannot pretend to have obtained information about all the various types of fund raising. What we offer in the paragraphs which follow is an anthology of the practices which have come to our notice. The examples given do not make up an exhaustive list, nor do they necessarily offer a representative sample, but they provide, we think, a fair indication of current strategies and attitudes in the universities. It would easily be possible to write a lengthy report which did no more than to describe the range of current modes of industry-university collaboration but we have had of necessity to be selective and thus offer no more than a summary of a vast and rapidly changing field.

121. There has long been multifarious interaction between the academic world and the world of business but the extent and variety of the differing forms of contact have both markedly increased in recent years.† A number of factors have contributed to this, notably the growing realisation that academic knowledge needs to be exploited if British industry is to remain in effective competition with its trading partners and, secondly, the acceptance by universities—particularly the newer 'technological' universities—that they need to seek out new and substantial sources of income at a time when Exchequer funds for research have been stagnant in real terms (and have in some cases, shown a sharp decline).

* *The future of the science budget*, Vol 2 (HMSO 1985) pp 68–78

† see, for example, CVCP: Universities and Industry (1981)

UNIVERSITY INCOME

122. At Annex J we set out (from UGC sources) a table showing (for the latest available year 1983–84) the recurrent income of each of the universities. As may be readily seen from the table the amount of income—and the proportion of the whole—obtained by universities from sources other than the main UGC block grant and fee income varies very considerably. Particularly relevant to this study are the variations in respect of endowments, donations, subscriptions, research grants and contracts. This data does not distinguish, within certain categories of income such as fees, private money from public money, but the general conclusion is that, for the year 1983–84 British universities as a whole received from non-public sources approximately 41% of the income produced by research grants, contracts and other services rendered.* The percentage for Salford University was 67%. This does not include receipts from wholly or partly owned university companies.

CONTRACT RESEARCH

123. Universities have for many years carried out research by contract, some of it largely non-commercial and funded by Research Councils, some of a commercial or potentially commercial character usually funded by industry or by government departments. Many of the commercial contracts awarded to universities come through established ties between major companies and specific teams or individuals in the academic community. Some of these ties may be said to constitute a well tested nexus of relationships between the universities and the world of business. Others are of a more ephemeral character deriving possibly from some new need in a particular company or through some personal contact, at a conference or seminar perhaps, between senior company executives and academic staff members. But increasingly links for contractual research have been forged as a result of conscious marketing strategies adopted by the universities, very often through the agency of companies or other institutional forms set up for the purpose and we look at these in the paragraphs which follow.

UNIVERSITY COMPANIES

124. Since the beginning of the 1970s a number of universities have set up their own companies within the university structure. It should be noted that income from such companies has not normally featured in the data covering private income of universities. A survey of university companies prepared earlier in 1985 (April) by university finance offices provided the following basic information: 33 universities and colleges which responded had established 77 companies; 26 had private limited companies; 5 had 6 companies limited by guarantee. Ten universities had companies covering all aspects of contract research for the institution, three had companies specifically for the overall exploitation of innovation. In the case of 52 companies the university held 100% of the shares. For the others the character of the shareholding varied widely although a majority shareholding by the university and/or staff was almost invariably the case. Eighteen universities had established unincorporated organisations offering such services: other universities either offered these services but did not have organisations of this type or had organisations but not for the purpose of offering academic services. The Wolfson Units for specific activities of quasi-industrial activity were quoted as examples of organisations of this kind. Of the 77 companies 34 covenanted their profits to the university; 43 did not.

125. In this survey universities were also asked to state what they saw as the advantages of a company as distinct from a service centre or research unit as organisational forms for generating private income. The answers were various with a very large number of reasons given as advantages to be derived from a university company. The following represent a grouping of these perceived advantages into two groups:—

NON-FINANCIAL ADVANTAGES were seen to include—

Scope for commercial decision-making outside the normal (and by implication slow and cumbersome) university committee system; avoidance of challenge to the charitable status of the institution; invaluable experience for academic staff; advantages in establishing effective commercial links to display a commercial image to potential clients (an organisation seen as clearly part of a university was thought to deter clients through appearing ‘academic’ in a remote and ineffectual donnish sense); operating results were more clearly defined; scope to bring onto the board of directors outsiders of great value to the enterprise; greater facility in providing technology transfer and in taking R and D forward to product development.

FINANCIAL ADVANTAGES

A separate company was seen as not being necessarily bound by the rules and constraints imposed on a university, eg over financing of buildings, charities, tax treatment, etc. Other advantages included scope to covenant profits and avoid the potential tax liability that a university would be at risk of incurring; eligibility for government (eg DTI) grants not available to universities as such; better scope for loan

* Annex J. This excludes payments from hospital authorities but assumes that ‘other sources’ and short courses provided income from private not public funds.

and equity funding; opportunities for participation in capital gains in the value of the share holding; benefits in terms of tax treatment for the university staff acting as directors; freedom from constraints of university pay scales and conditions.

126. In the early years the companies which proliferated mostly had the aims of undertaking consultancy and industrial R and D in a general sense. More recently companies have been set up to cater for specific needs as, for example, in the software engineering industry, development of high-technology products, drug-formulation and publishing.

127. In terms of tax benefits (a point frequently mentioned in the Finance Officers survey and explained in the CUA report) the advantages of a wholly-owned university company is that the profits are ploughed back into the university under a deed of covenant. The company has to pay corporation tax on any surplus but the university is able to recover the tax paid.

UNIVERSITY RESEARCH POSTS

128. Assistance with the foundation of professorial chairs, research fellowships or other posts has long been an accepted mode of support by wealthy individuals, charitable foundations and industry on both sides of the Atlantic. Precise information about the extent of this practice was not available to us but we were able to form some impressions from our conversations with the CVCP and with industrial companies. The details of any particular post vary but the spectrum ranges from the benefactor providing a capital sum for the complete cost of endowing a post in perpetuity to an annual grant for covering costs for a number of years. It is not clear, in the case of the provision of capital sums, how this money features as 'income received from private sources'. We received the impression that companies were tending to offer initial support for a limited number of years (which raises difficulties for universities in present circumstances) rather than outright endowments and that it was doubtful whether this flow of benefactions could be greatly increased beyond its present level.

129. This conclusion may be too pessimistic because it is derived from the views of the main corporate funders of research in British universities. Greater capital endowments may be possible from very wealthy individuals who have prospered by creating successful new businesses, particularly perhaps businesses which have owed part of their success to their nexus with science.

EXPLOITATION OF INVENTIONS

130. The Government has recently abolished the monopoly rights of the British Technology Group to the first refusal of the commercial exploitation of research funded by the Research Councils, the object being to confer more responsibility on individual researchers in universities and to increase their incentives to exploit their own research results. In future universities and the researchers will be free to retain any income arising specifically from exploitation without loss of general funds and to use general income from their UGC grant and fees to develop their arrangements for exploitation. This has been warmly welcomed but it remains to be seen how far it will, in practice, constitute a wholly new deal for the academic world and the Research Councils. The Working Party has been made aware of the widespread feeling that substantial benefit from the concession will not be derived unless there is a more rigorous and commercial approach to the exploitation of university research in co-operation with industry. The view has also been expressed that changes in the patent laws may be needed before UK (and European) institutions are on a footing comparable to that already enjoyed in the USA.

131. We are left with the feeling that there is much potential scope but that there are policy and organisational problems to be overcome within the universities before the various participants can feel assured of greater success in securing exploitation. We are aware that many universities (perhaps all of them) are hard at work preparing plans for such ventures and we urge that all institutions should make every effort to take full advantage of the new opportunities that have been opened up.

SCIENCE PARKS

132. Deriving from earlier American experience the science park—using the definition employed in the CUA report 'a planned development of high-technology enterprises in an attractive physical environment with close links to a university'—is arguably the most complex and highly organised of all the various modes of industry-university collaboration. It has received great publicity as a concept and many hopes are pinned upon this mode of development, but we are conscious that the science park remains a highly-specialised case of university-industry links.*

133. Nearly 30 UK university-based science parks are in being, at the planning stage, or under consideration. In Britain, as in the United States, there are substantial differences of character and style between

* see J Lowe: *Science Parks in the UK* (Lloyds Bank Review, April 1985).

science parks and it has been said, with justice, that no two science parks are alike. We understand that at most only about a dozen of the British science parks are operating with anything approaching a full complement of industrial tenants with probably only two—Cambridge and Heriot Watt—entering what, by American criteria, at any rate, would be recognised as a mature phase of development.

134. Certain different types of science parks may be distinguished. The 'purest' form, from a university point of view, could be said to be the research park usually sited close to or even on the campus of a university. Here the main area of activity is academic/industry liaison in the new technologies. Typically, the university will retain the dominant role in the management of this kind of park with scientific advance seen as being of greater significance than the income generated from the industrial tenants.

135. By contrast the term science park is probably more accurately applied in a situation which, although not unlike the research park, sees developmental work as being as significant as research. In such a setting at least some prototype production facilities may exist. A third variety has been identified by some commentators, the technology park, which is typically a development to accommodate companies engaged in the commercial application of high technology. Academic involvement may well be low and there may be a not inconsiderable element of production, sales and servicing work. Commentators on the science parks have noted that some science parks evolve into technology parks or even develop beyond that into 'business parks' where R and D is of little importance and the site is really little more than an attractive industrial estate. Personal contacts with university scientists can remain important nevertheless.

136. Some experts have identified four important objectives which science parks (of whatever character) may be said to share. First, they can offer a mechanism by means of which university companies can evolve to form a focus for new developments. Secondly, they can serve as a bridgehead through which technology knowledge can be transferred between the academic community and industry. Third, science parks could be said to enable the academic community to maintain contact with commercial priorities. A fourth function has been identified: science parks may encourage the development of a culture in which academics and businessmen can generate further collaborative research and enterprise. It seems to use that these objectives could be and sometimes are achieved without the existence of a science park but we can see that the formal organisation of the science park may serve to promote the attainment of the objectives and to encourage larger and more ambitious developments than would have been possible otherwise.

137. The Cambridge and Heriot Watt parks were the pioneers in this country and their success, albeit at a fairly slow rate of growth, encouraged others to follow suit.* An additional stimulus—if, in a sense, an unwelcome one—came later when government cutbacks on university funding forced academics to look for new employment and funding opportunities. Other factors, including a greater readiness on the part of venture capital and the financial interests to go into technology, attracted by the reputation of the concept, provided an additional stimulus which permitted a number of new parks to be started.

138. The Cambridge and Heriot Watt parks have both embarked on new phases of development. Their tenant firms range from small to large; both have continued to lay much emphasis on potential for scientific development and co-operation with the university in admitting tenant firms. Since the beginning of the 1980s various schemes for new science parks have been started and others are at the planning stage. It should be said that the Cambridge Science Park was set up by Trinity College (as landlord and developer) rather than the university. The science park and the 'Cambridge Phenomenon' of the rapid spread of high technology firms in the locality have not brought direct financial gains to the coffers of the university.

139. A number of general factors have been identified in the operation and development of these otherwise widely differing institutions. The early parks were essentially university initiatives on university land but had the character of speculative developments to increase industrial liaison. At a later stage local authorities concerned with restructuring the local economy and creating jobs become involved. Similarly, financial institutions, encouraged by Cambridge and Heriot-Watt, entered the field in the later developments. The pressure to make full use of park facilities has, in some cases, led to dilution of the original concept and evolution into business parks. In more recent developments speculative building has been a prominent feature with attendant problems of under-utilization of available units.

140. As noted in the earlier part of this report much attention has in recent years been focussed on the science parks. The more perceptive commentators have however, expressed reservations about the present success and future prospects of this growth and we share this cautious approach. The indications are that the original science parks which were set up with a firm base in a university and which have grown steadily over a period of years to achieve a mature and established reputation are doing well. The evidence also suggests that more recent developments have traded on this early enthusiasm (and the reputation which science parks have enjoyed in the United States). Some of the critical studies of science parks maintain that

* see Segal, Quince and Partners, *The Cambridge Phenomenon* (1985).

some ventures were started in haste in order to take advantage of what was widely thought to be a lucrative new growth area. Such initiatives were powerfully assisted by government cutbacks in academic funding. In consequence we understand some of the science parks have yet to become fully operational while others have suffered from tensions between the property speculators, the host university and the other participants, with too great a readiness to fill the industrial units available for rent without full consideration of the best needs of the university. Much of this criticism is, inevitably, anecdotal reportage which we are unable to evaluate but we think, again, that there is some truth in it. More information is desirable. What cannot be disputed is that science parks are expensive to set up and run and we suggest that any university which does not now have a science park but is thinking of establishing one should consider carefully whether it could achieve its objectives of developing fruitful links with industry and commerce by means of more traditional modes, such as the establishment of university companies or the development of 'clubs' subscribed to by firms rather than by a costly and possibly risky fixed investment in a science park.

INDUSTRIAL LIAISON OFFICES

141. Some 20 years ago higher education establishments received Whitehall support for the establishment of industrial liaison offices. Most universities now have Industrial Liaison Officers (ILOs). These officers meet regularly on a national basis to exchange information and ideas and to develop co-operative links, often on a regional basis. With the growing acceptance of the need to establish closer ties with business and to identify new sources of funding the ILOs would seem to have high potential importance. We find it difficult, however, to evaluate the work of the ILOs. Some of the industrialists and venture capital executives we met left us with the impression that the system was less than fully effective and that a more dynamic and flexible approach than that often displayed by the ILO was required. In their view ILOs were not enough.

ALUMNI SUPPORT AND FUND RAISING APPEALS

142. The search for income from private rather than public resources by the universities goes much wider than seeking funds specifically to finance their research activities. Of course, private income, however generated, may help the funding of research costs, directly or indirectly by means of internal transfers, so that brief mention may be justified here of these wider efforts by universities to raise money. It is well known that American universities and colleges have long been remarkably successful in obtaining substantial funds through the activities of their alumni associations and through appeals to the business and wider communities. Recent figures show that voluntary funding of all kinds in the United States stands at about £3,200 m a year, a substantial part of it raised from past or present students. It is the alumni who make up the largest source of private funds on a continuing basis for most American universities. The CUA Working Party went into the matter of alumni support and fund raising appeals in some depth and set out a useful description of what is at present done in UK and what more might be achieved. The overall picture is of a general lack of a highly developed graduate relations tradition in Britain with a largely untapped potential here for fund-raising among former students. Some universities—and particularly individual colleges at Oxford and Cambridge—have been notably successful in encouraging former students and other benefactors to contribute but such fund-raising successes seem usually to have been achieved in the context of special 'one off' commemorative appeals, and designed in particular to raise capital sums for new buildings.

143. So far as general fund-raising (as distinct from specific appeals directed to former members) is concerned some UK universities have achieved some notable successes. The modes of fund-raising can vary and, as in other aspects of the private funding of higher education, transatlantic experience may well provide—although with qualifications—a useful indication of what might be achieved here. It seems doubtful, however, to the Working Party whether such general fund-raising will be important in the aggregate as a mode of financing research programmes, particularly programmes in fundamental research.

OTHER SOURCES OF FUNDS

144. Provisions of short courses has long been accepted as a legitimate activity for a university, especially if seen as part of its responsibility to the community at large, a point brought out very effectively in the 1984 report of the UGC Working Party on Continuing Education. It is unnecessary for us to quote examples of this familiar aspect of university income-raising activities. The same is true for other universal activities long established in the university system but now being developed more vigorously under the stimulus of financial adversity: summer schools (and now more elaborate 'summer academy' projects), income from foreign students, vacation letting of university and college premises.

OTHER MODES OF COLLABORATION

145. We have noted at the end of the Research Councils' part of this report three effective collaborative schemes involving industry, higher education and one (and sometimes more than one) of the Research Councils viz the Alvey initiative, the CASE awards and the Teaching Company Scheme. These ventures do not, of course, primarily set out to generate significant income for the participating universities but they afford valuable scope for widening the experience of the managers, teachers and students involved and con-

tribute towards building up a greater understanding in the academic community of the needs of industry and vice versa which may then encourage the funding of research in other ways.

THE UNIVERSITIES—CONCLUSIONS

146. Figures from the Universities Statistical Record show that universities as a whole received their highest ever income from industry (in the latest available year) at a time when their real level of income from Government fell. Income from contracts with industry increased by 21% in 1983–84 and exceeded £32 m. Income from endowments and donations also increased by 17% to almost £23 m and there was a 14% increase in income from research grants and contracts. In total, money from outside sources increased by almost £60 m. This trend was confirmed in the House of Commons in April 1985 when the junior Education Minister showed in Parliamentary answers that between 1981–82 and 1983–84 universities' income from non-Exchequer sources increased from £91 m to £134 m, an increase in real terms of about 35%; and that since 1979 contributions from private sources had risen by 18% in real terms.

147. However, the UGC figures quoted earlier in this report show that Exchequer grants, home student fees and Research Council grants far outweigh non-Exchequer income and Education Ministers have continued to express the hope that there could be scope for an increase in the proportion of total income represented by private funds. We note, however, that such optimism finds only a qualified place in the Government's Green Paper 'The Development of Higher Education into the 1990's' (HSMO Cmnd 9524 May 1985). Indeed this text recognises that none of the schemes intended to change the balance of funding have been '... without serious difficulty, and the Government concludes, with regret, that no substantial part of established public funding responsibilities can be shed' (Green Paper paragraphs 9.4–9.5). Our investigation endorses this guarded approach to the prospects for significant private funding and we believe that the Government is right to be cautious in its expectations, particularly in the short-term.

148. Earlier in this report we noted the various ways in which universities were already seeking funds from non-exchequer sources and their different modes of collaboration with the private sector. The variety of such mechanisms shows that universities are alive to the need to seek out new sources of funding and to strengthen their contacts with industry and commerce. Individual instances of successful collaboration with industry in every mode can be cited. However, these do not form a representative sample: there is a wide gap between 'best practice' and the average level of 'diffused practice'. The problem therefore is to generalise 'best practice' instances to make them more representative. We have concluded from our discussions with industrialists and venture capital interests that certain constraints exist which at present restrict the extent of private funding and university-industry collaboration. Many arrangements, newly formed or under discussion, have yet to bear fruit, which will help to explain the discrepancy between the views of industry and the optimism of the universities in this regard.

149. As noted elsewhere in the sections of this report dealing with industrial attitudes there are differing viewpoints within the private sector but we encountered a widespread conviction that universities at present often displayed too many attitudinal and institutional difficulties—from the industrial point of view—to permit greater collaboration and more generous funding. The belief, rightly or wrongly, that university staff are not commercially-minded, and have little appreciation either of what might be commercially exploitable or of the realities and constraints of the world of business seems to be widely held in industry and commerce. Some of this may be sheer prejudice but we think it is not entirely without foundation; more specifically, we see force in the business view that university staff operate to different timescales, may be too casual about the requirements of commercial confidentiality, and can often be too burdened by their teaching responsibilities to concentrate effectively and speedily on R and D for industry. Conflict can easily exist between these imperatives of confidentiality in contract research in the commercial context and the normal assumptions of a public demesne of knowledge and ideas in the academic world. They can be minimised if identified early, if close liaison is maintained and conditions are specified on both sides.

150. A further widely-held critical view is that university organisation is, from the commercial viewpoint, insufficiently inter-disciplinary to make for fully effective collaboration. This viewpoint widens into a general feeling that there is a need for a more specific and articulated institutional response from the universities if they are to present themselves to industry as desirable collaborative partners and deserving recipients of more private money. Other closely related criticisms previously put to us included the industrial belief that universities were too incoherent and cumbersome in their internal mechanisms with slow and tedious committee processes and often a lack of a clear understanding within the university of financial flows and responsibilities.

151. We found a general measure of agreement in industry that, despite the considerable efforts by individuals or teams in nearly all universities, there was perceived to be a shortage of suitable 'bridgeheads' by which effective contacts could be set up and developed between universities and the private sector. In a sense we find this somewhat surprising given the proliferation of university companies, the apparently considerable and long-standing contact between—at any rate—the major industrial companies and the academic world

and the variety of other collaborative modes already existing. In this connection it was more than once put to us that the ILO scheme had been less than fully effective and that it was insufficient for a university to rely on this mechanism as a suitable bridgehead for industrial contact. The scheme is now some 20 years old and we think that it may be due for rigorous examination. Perhaps executives with business experience might play a larger role. It would seem that it is best left to individual universities to reappraise their ILO network and to consider how relevant it is to the developing needs of the late 1980s.

152. The new freedom for scientists working in universities and Research Councils—and for the institutions themselves—to enjoy the proceeds of patents and licences resulting from research funded by the Research Councils has stimulated much activity. Ending the monopoly of BTG over the rights of first refusal of such commercial exploitation, however, is not of itself a sufficient condition to produce high returns for the successors. Few patents and licences, in fact, have proved large earners (and those few have created uncritical optimism). But to harvest the commercial fruits of such research requires an appropriate organisation. Paragraphs 124–7 of this report set out many of the perceived advantages of university-owned companies, specially established to capture such gains. These views, collected by University Finance Officers, were echoed in the message we received from the business community. Their requirements were: to do business with an organisation which had clear terms of reference and powers, with executive responsibility and authority, able to respond quickly and effectively in negotiations, able to set up a contract and then monitor it efficiently. Essentially they looked for the sort of organisation which reflected their own ideals of doing business. The executives of such university companies need to deploy managerial (not to say entrepreneurial) effectiveness. The same demands for clear-cut terms of reference, powers and responsibilities would be necessary if a university was seeking joint participation in such a company with a venture-capital business, or even raising a loan from a bank to establish a company of its own.

153. Many variants are evolving in the detailed organisational form of such companies. Options will differ. However a high common factor of general conditions will need to be met by all of them. Ground rules have also to be established within universities and Research Councils for the respective rights of individual scientists and their institutions over the commercial exploitation of research carried out in the institutions. Given the present ferment of activity in the universities on this front and plans by some Research Councils to extend their commercial activities we think that liaison and co-ordination will be necessary to establish common criteria. (We do not suppose that universities will adopt a uniform set of arrangements). Great variations exist between universities; even between departments in the same university. Some variations exist between the practices of the Research Councils but most were implementing their rights as employers under the 1977 Patent Act.

154. More extensive contact with industry for contract research will demand similar organisational responses by the universities and Research Councils. Indeed, there is no absolute division between contract research, direct exploitation, patenting and licensing. A major research programme might lead to all these modes of exploitation at different stages, as it evolves into new technology and products.

155. There is, we think, plenty of scope for universities to do more in the way of organised fund-raising directed both to past students and to the general public. The CUA report has detailed information and guidance about fund-raising which we could not improve upon, although we suggest in this connection that universities might perhaps do more (possibly by means of CVCP as a clearing house) to exchange information about fund-raising and similar activities. The Working Party considers, however, that while it is undoubtedly true that it should be possible to raise a sizeable amount of extra money from well-directed fund-raising initiatives the prospects may not be as glowing as is sometimes made out, more particularly for funding research. Two factors must be borne in mind: first, UK experience, especially at the collegiate universities, shows that it is much easier to raise funds for new buildings such as a new residence block, hall or library—than for equally worthy but less easily identifiable purposes such as research programmes or research posts—and we think that it may not be easy to mount an effective fund-raising campaign in order to increase a university's recurrent income. Our other comment is that it may be unwise to attach too much importance to the enormous success, over many generations, of United States universities and colleges in encouraging their alumni to contribute, often on a regular basis, to their funds. American institutions seem to be able to maintain much closer and more effective contacts with their former students than is common in Britain (Oxford and Cambridge colleges apart). Secondly, American graduates in all age groups are generally far wealthier than their British counterparts and they are encouraged by a more generous tax system than in this country. We think that, even after allowing for the differences in population size between the two countries, it would be realistic to assume that British academic fund-raising would probably not produce more than a tenth of what an equivalent initiative could expect to achieve in North America. We do not comment here on the other methods of raising current income from private sources because we consider these will only have an indirect effect on universities' abilities to fund their research.

RESEARCH DATA-BASES

156. We favour the creation of 'data-bases' which provide details of who is doing what research in which institution. In the course of this enquiry we were often told that smaller firms, without close links with the world of academic research, found difficulty in acquiring such information; and even larger firms, when running up against a research problem in a field where they had no expertise of their own or known contact, might also draw on such a data-base. Many safeguards are needed in the creation and operation of such facilities, some of which are currently being aired in the case of the comprehensive data-base being assembled for publication by Cartermill. Many more specialised registers of research have already been published. We do not see one single comprehensive index taking the place of all other initiatives but rather the creation of facilities following specialisms both on the research-output and the demand side for such data. Each university and Research Council could also be so equipped with advantage. It was suggested to us that the CVCP (or the UGC) was the best central organisation to collect and collate comprehensive information on the university side and perhaps DTI the best base from which the facility might be operated, if it was to be based in the public sector. We were impressed by the awareness of the need for rapid access and response—perhaps even by telephone. In any case such data would need to be held on computer file for rapidity of input, search and up-dating.

157. In drawing together the various aspects of the university scene we suggest that there are two fundamental considerations underlying what we have been discussing. The first is the extent to which the various modes of private income-raising, and commercial collaboration could be said to be directed to the support of basic research as distinct from applied research and development. Nearly all the present or possible future collaborative modes we have considered—the university companies, the science parks, the university-industry 'clubs' are, as we understand it, mainly directed towards involvement in applied research shading into development work and commercial exploitation. In certain expanding fields, however, where the gestation period between advances in fundamental knowledge and commercially-exploitable consequences is short, collaboration with industry should be possible for 'strategic' research, as the recent Monsanto grant of \$5 m to Oxford for protein research indicates.

158. We think that the main opportunity for universities to increase private funding for their basic research lies in the generation of income through industrial collaboration in the more applied fields which could then be redistributed within the university towards the support of basic research, in accordance with departmental priorities. This would seem to suggest an emphasis on income-generating university companies and on lucrative contract research for the private sector. But this leads to the second fundamental consideration: the extent to which universities should gear themselves to meeting industrial needs and to expending staff time on entrepreneurial activities at the expense of the traditional teaching, basic research and administrative functions. There is clearly no easy answer to this and opinions and priorities differ within the academic community. Faced with governmental cutbacks administered through the UGC some universities, we know, have deliberately gone along the path of devoting a sizeable part of their corporate effort to catering for commercial needs. On the other hand we acknowledge the belief, strongly held in many university quarters—and the point has been vigorously put to us in discussions with the CVCP—that the true function of a university is to teach and to undertake fundamental research and that it is wrong to put large amounts of staff and other resources into applied research and developmental work, at the behest of industry, which is disconnected from the scientific priorities of the departments concerned. Here again, however, we think that there is evidence for believing that the common ground between industry and academic research is potentially wider than commonly recognised (paragraphs 270–76).

159. It is no part of this Working Party's terms of reference to seek to tell universities what they should do. If the universities want central guidance they will seek it from the CVCP or the UGC. Individual universities will decide what their priorities are balancing possible commercial advantage against the importance of traditional research functions. Some universities will place greater emphasis than others on the priorities of income-generating commercial links. We see a potential danger, with a continuation in the attrition of UGC and Research Council funding to the universities, that some parts of the university system may become too devoted to contract research and to the demands of university companies and science parks. We believe that diversity amongst the universities is to be welcomed.

B. ATTITUDES OF POTENTIAL FUNDERS:

1. INDUSTRY

INTRODUCTION

160. Within the constraints of the limited time and staffing resources available to the Working Party an attempt was made to sound out the attitudes towards research of a cross-section of industrial companies. This theme is much wider than the topic of support for research in the Research Councils and universities, with which the Working Party is specifically concerned, but the sponsorship of such research by industry has to be seen within the context of this wider picture—by which it is largely determined. And industry remains by far the largest potential funder of research beyond government.

161. We investigated the attitudes of industrial companies towards R and D in two ways. The Working Party arranged a programme of discussions with research directors of large companies known to have a substantial R and D commitment. The discussions were based on a checklist of questions covering their attitudes towards the research spectrum ranging from pure research through to development; the criteria which determined the distribution between in-house and extra-mural R and D, their relationships with Research Councils and higher education; the variety of modes of funding including contract research, collaborative schemes, gifts and endowment of research posts; present constraints and possible changes which would encourage greater funding of research in these establishments.

162. In addition to these discussions the Working Party was assisted by Miss Jones who carried out a programme of interviews with directors of research of a wider sample of companies than the full Working Party was able to meet. The results of these interviews have been assimilated into this report. Manufacturing companies from a variety of sectors of industry were interviewed although time constraints did not permit a survey of smaller companies. Comments on the role of R and D by small companies, are however, included in paragraphs 165–6 of this chapter.

163. A list of companies interviewed by Miss Jones is at Annex L. We must point out that owing to the confidentiality of some of the information provided during the interviews, some comments in this report are non-attributable and specific details which were provided to the working party have been used as a basis for more generalised conclusions.

FACTORS AFFECTING COMPANIES' ATTITUDES TOWARDS R AND D

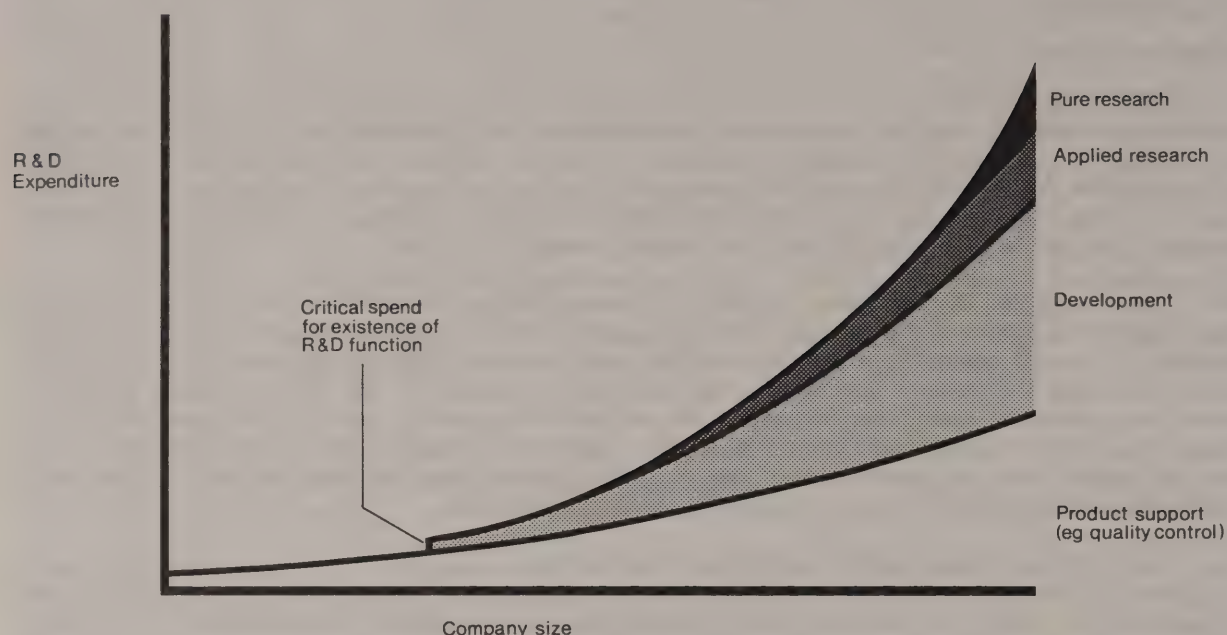
164. The most important conclusion, which became at once apparent to the Working Party through the interviews, was the diversity of attitudes towards the funding of research in the business and financial world. In no sense was there a homogeneous or uniform pattern about which simple generalisations could be made. We found that the most significant variations in companies' attitudes towards R and D were by industrial sector. Paragraphs 202–223 analyse this aspect. There were, in addition, 4 other significant determinants identified by the Working Party: company size, profitability, ownership and personnel.

Company size

165. The Working Party was unable to conduct interviews with representatives of small companies. However, some companies that were interviewed were asked how company size in their sector of industry would affect attitudes towards R and D and input of this kind is included in the report. In general the relationship between company size and the sponsorship of R and D is schematised in figure 1: only the largest firms are concerned with pure research, and there is a correlation between the size of firm and the extent and nature of R and D undertaken and sponsored. This is evidently much influenced by the long time-scales involved between strategic research and the emergence of a viable trading product or process, which only the largest companies could entertain. In general smaller companies need quicker commercial returns to survive.

166. In this connection we observe that the report of the House of Lords Select Committee in 1982/83 noted that in 1978 79% of R and D within industry was conducted by firms with more than 10,000 employees. The Working Party discovered that there appeared to be a threshold, in terms of resources employed, below which it was not beneficial for a company to carry out any R and D: the maintenance of in-house research facilities simply required too great a commitment of resources for small companies. So far as extra-mural research was concerned, the companies which benefited most were those which had their own team of research scientists who were closely involved with the conduct of the research by the external body. This gave the company greater control over the direction of research and facilitated the transfer of results into the company's own research division. Again, a considerable commitment of skilled staff resources at a quite senior level was required. Research scientists employed by the larger firms maintained close general links with the academic and professional community, following their own professional networks, so that information and personal contacts were easily maintained. But, as a generalisation, we found that large companies which

Figure 1 Type of R&D by company size Not to scale



were research oriented preferred to conduct as much as possible of their R and D in-house, as they found this mode of operation more cost-effective and offering greater control over its direction.

167. Very small companies would carry out no R and D but technical services might exist for product support such as quality control. Medium sized companies might sponsor developmental work, and some applied research. Pure research would only be found in the largest companies. This generalised picture conceals considerable variations across sectors of industry (paragraphs 202–203). In principle smaller companies without research facilities of their own could profit greatly from contact with research scientists and facilities in universities and polytechnics although many will make use of Research Associations. In practice this category of firm experienced the greatest difficulties in making such contacts in the academic world. Equally universities find it easier to collaborate with large companies and organisations that have established research staff. Much scope exists, particularly on the side of universities and polytechnics, for closing this gap and we consider that academic institutions should take the initiative in establishing the necessary bridgeheads with smaller companies.

168. One exception to the generalisation concerning small companies recorded above was the group which had developed specifically from research conducted in an external research establishment—typically a university department. These companies maintained close links with their parent source and generally sponsored more R and D than other companies. ‘High-technology’ companies emerging as small firms in newly established fields of technology, which are small because they are so young, remain another exception. Time will tell whether this correlation between high commitment to research and small size will survive in their case.

Company profitability

169. We noted that the size and management of the R and D portfolio was affected by the company’s overall profitability. A fairly common response to a short-term reduction in profitability was evidently to cut the total R and D budget. This would usually be achieved by shelving longer-term research and cutting back on extra-mural work because economies of this sort could be achieved with less disruption. However, when a company’s profitability was in long-term decline, in-house research capability might be sacrificed to reduce overheads, and substituted, to some extent, by extra-mural research which allowed for greater flexibility in funding year on year. Many companies emphasised that the prospects for increased funding of R and D in the future depended ultimately on the long-term success of the company (a causal relationship which was not, in our view, necessarily unilateral).

Company ownership

170. Company spokesmen working in the research and development sides in industry referred to their belief that shareholders had a preference for short-term profit gain, which limited the amount of longer-term research work which could be undertaken since, under the Statement of Standard Accounting Practice 13, all such expenditure had to be written-off as incurred. Their perception is significant, whether or not it accurately reflects the impact on share prices which public knowledge of R and D expenditure would produce.

171. It is theoretically implausible that if longer term R and D work does have a positive net present value, that it should be reflected in stock market valuations by a negative impact upon prices. This would mean that companies undertaking R and D on any scale would be systematically undervalued by the market as against those who did little. Assertions that the stock market has short-term horizons which cause an adverse attitude to R and D expenditure are common in the USA as well as here. The office of the Chief Economist of the Securities and Exchange Commission in Washington has undertaken a study (April 1983) which 'strongly refutes the proposition that the stock market values only short-term earnings, and not expected future earnings'. A comparable study of British data should be made: there is however certainly one major difference between the US and ourselves—in the USA companies are required to disclose the level of R and D expenditure written-off as a charge against profits, but we do not require it to be disclosed, and many companies do not in fact do so. Company opposition to the disclosure of such information was a factor in the 1981 Companies Act not requiring such disclosure. It would help stock markets to reflect a positive value for R and D if they knew what it was.

172. The constraints on public-sector industries and organisations, however, were of a different nature. Some had been able to take a longer-term view as there was less pressure to justify research expenditure in terms of a commercial pay-back period; and there had, in the past, been a 'patriotic flavour' to some long-term research. However, imposition of tight cash limits in an increasingly competitive environment meant that these distinctions between the public and private sectors were no longer easily sustained.

Personnel

173. In many cases we found that it was not possible to draw general conclusions on attitudes towards R and D of companies by sector, size, profitability or ownership. Frequently it appeared to be the influence of key personnel within the company which was the dominant factor.

ATTITUDES OF INDUSTRY TOWARDS RESEARCH

174. R and D encompasses a wide spectrum which ranges from 'curiosity orientated' basic research which has no foreseeable commercial application, through to the development of, and technical support for, products and processes prior to commercial operations. This study concerned itself with analysing the present, and possible future, shape of the distribution of public and private funding of R and D across this spectrum, but our concern was more specifically concentrated on the research requiring funding in the Research Councils and universities, where the main problems lie towards the 'fundamental' or 'basic' and 'strategic' research end of this spectrum.

175. The vast majority of R and D sponsored by industry was carried out using companies' in-house facilities. It appeared that less than 5% was extra-mural. Generally speaking large companies would not conduct extra-mural research on grounds of cheapness because, as has already been noted, in order to obtain maximum value from such research it was necessary also to devote resources to an internal team of research direction to control the programme, to direct it towards commercial ends and to aid the transfer of results. Most companies preferred to carry out as much as possible of their research in-house trusting their own commercial judgement on priorities unless they required particular expertise. Initiation of contact with external expertise was often achieved through personal links at research bench level, aided by conferences and the technical literature of the journals, membership of learned societies and professional institutions, or through approaches to known 'centres of excellence'. The premium placed on such personal contact was clearly very great.

176. The Working Party attempted to sound out the attitudes of companies towards conducting research in universities and Research Councils; to discover the nature of the constraints in such funding, and to discover what changes were thought to be necessary if extra funding was to be achieved and to assess the likelihood of such an increase. Research associations are another type of establishment which are used by industry to conduct extra-mural research and are considered in paragraphs 105–8.

Basic research

177. So far as long-term basic research without foreseeable applications in universities and Research Councils was concerned, every company representative interviewed by the Working Party stressed that this

was a public responsibility and hence needed to be financed through public money funded by government: there was virtually no likelihood of persuading industry to finance it. Two main reasons were advanced for this view:

- i. as basic research was carried out with no application in view, it could not be justified in terms of commercial opportunities balanced against commercial risks. The time-scale was long and indeterminate, even if unanticipated commercial opportunities eventually resulted from these advances in scientific knowledge. No incentives therefore existed to counteract the disincentives facing industrial firms over such a choice. It was consequently necessary that such research should be centrally funded, at least until the commercial applicability to a particular industry could be perceived;
- ii. companies considered that they were already financing basic research in universities and Research Councils via taxation and they did not wish to pay twice over.

178. Many of the companies interviewed acknowledged that their long-term success depended upon a constant stream of high-quality basic research being conducted, as this was the source of potentially commercially profitable applied research in the future. We were told many times that it was vital that the Government should reaffirm its commitment to maintaining a sound base of support for basic scientific research, particularly in the universities. Several companies said that they would not contribute towards the financing of basic research themselves because this would risk encouraging the Government to diminish its own support. Adequate university provision for research was also seen to be critically important as the source from which the flow of skilled scientists would be sustained.

179. Some mitigation of this view was apparent in discussions about 'strategic research'. This would be identified as research motivated by the desire to advance scientific knowledge for longer-term advantages and without specific 'developable' technology in view. However, in contrast to 'basic research' 'strategic research' would be orientated towards particular fields of knowledge where profitable future applications may be anticipated, if in the longer-term and without specific anticipatable realisation in new products or processes. In certain fields of research, where the time-scale between the advance of new basic scientific knowledge and its applications is relatively short, and growing shorter (as with certain aspects of medical technology, drugs, aspects of molecular biology such as protein science, bio engineering and the like), strategic research may well be able to attract industrial funding, even though in a 'pre-commercial' context.

INDUSTRY'S RELATIONSHIP WITH RESEARCH COUNCILS

180. We found that companies' relationships with Research Councils varied considerably. To the extent that the differences could be classified according to industrial sector, the findings are recorded in paragraphs 202–223.

181. On the whole, companies expressed little enthusiasm for using Research Councils for contract research; where this did occur it was usually because of a particular facility which they wished to use, or because they wished to develop contacts with a known 'centre of excellence' in a particular field. Companies did not find that Research Councils were sufficiently geared up towards contract research; they often appeared out of touch and generally lacked flexibility and receptiveness to the needs of industry.

182. We found that industry was not interested in contributing to a 'pool' of funds which might be distributed to the Research Councils or universities. Individual companies would only provide funds (if at all) negotiated by themselves which were earmarked for a specific project or research team. This meant that companies would sponsor the projects in universities, for example, directly, perhaps using the Research Council as a broker or catalyst. This was mitigated in certain specialised fields where 'clubs' had been established, as with SERC for pursuing research jointly financed at a 'pre-commercial stage' (see paragraph 58).

183. We detected a widespread feeling that the Research Councils maintained too low a profile, and could do far more to generate awareness of the facilities and expertise which they had to offer. Some companies found it difficult to discover where relevant work was being conducted in universities and Research Councils. If they so determined the Councils could play a greater role in managing the national programme in specific fields of research and facilitating the information flow between industry and the research community. The Research Councils represented a considerable national resource which could be used on a wider scale than at present to provide centralised facilities, such as large physical instruments and even libraries for specific areas of scientific research. Some organisational response within Research Councils, as with the universities, is required to lessen the constraints at present perceived by industry, if much greater commitment to private earnings is to be achieved.

184. We found that, in general, companies' attitudes toward the Research Councils appeared to be that their prime functions were to carry out basic research and training, fund university research, and provide centralised facilities. It was generally accepted that these were important on a national scale, but were not

of much direct relevance to the needs of industry. It was therefore felt to be important that the Government should continue to fund such work and make the benefits as accessible as possible. However there appeared to be little likelihood of attracting industrial funding for basic Research Council work. These views may well have been influenced by the fact that we discussed such issues mainly with the representatives of large companies with extensive in-house research facilities of their own. We considered that the extent of common ground, upon which collaborative programmes might be based, was greater between the Research Councils and industry in some fields than was currently perceived on either side.

INDUSTRY'S RELATIONSHIP WITH THE UNIVERSITIES

185. Attitudes expressed by companies towards university research varied considerably. There were those who saw the purposes of universities as being to carry out basic research and to provide a continuous source of first-class graduates, well trained in the methodology of research. We found that these companies were generally well satisfied with the current performance of universities in these respects, and had developed close working relationships with particular departments and individuals. From such personal contacts, of course, cooperation of different kinds, contracts and benefactions might well flow. They said that they would not welcome any development which might prejudice the excellence of basic research and training and it would therefore be inappropriate for university departments to be forced into commercialising their operations generally in order to survive. The example of Salford University, where an industrial liaison team had been set up to commercialise university departments, might be beneficial for small companies around Salford which did not already have close links with the university but this was not a model, it was felt, which should be applied universally in the university world.

186. However, at the other extreme we found that there were those companies which considered the industrial orientation of academics to be seriously lacking, particularly when it came to contract research in applied fields. Scientists in academia were often inexperienced in applied research, in contrast with those working in Shell research for example, which had a policy of moving its researchers through a variety of research programmes. They were also used to working to more relaxed time-horizons and appeared to be inflexible in responding to the pressures of the commercial world. In this respect universities had a poor record in comparison with contract research companies. In part this was an attitudinal problem, but it was not helped by the long university vacations and the commitment to undergraduate teaching and examinations which placed serious constraints on their freedom of operation. Academic priorities for publishing the results of research and problems of maintaining confidentiality where research lay within a potentially commercial context were also cited as constraints which inhibited the flow of commissions from industry to the universities.

187. As with the Research Councils, companies told us that they would not provide funding for university departments in general, but might support specific research projects or teams. It was more cost-effective for a company to sponsor a research project directly than to go through a third party, as well as giving the company greater control over the direction of the research.

188. For many companies, the primary purpose of sponsoring research in universities was to develop contacts with known 'centres of excellence', in order to keep in touch with developments in scientific research in particular fields. In this way companies kept intellectually alert and were able to move quickly into new areas as and when potential for commercial development was perceived.

189. Another main reason for involvement in research in universities was that this served as a recruitment mechanism. Companies seeking to recruit a small number of first-class science graduates each year found this to be an effective means of making contacts. Collaborative schemes such as CASE were seen as especially valuable in this connection. A similar motive was sometimes apparent when financing chairs and other university posts.

190. Companies would not usually commission basic research in universities but some of the larger companies which had developed close links said that they would use their various co-operative arrangements to nudge academic partners towards areas which they believed to be promising. We noted one example of this where ICI had put together a small team of researchers in a particular field which developed expertise to enable it to forge contacts with centres of excellence in the universities and Research Councils outside the company. This was a long term project; commercial benefits would not arise for 10 or more years, if at all. This type of activity could only be provided by the largest companies in those sections of industry where there was a relatively short time scale between research and commercial development, and where it was necessary for companies to become involved at an early stage in the R and D process. This point is developed in paragraphs 204–12 on the chemical industry.

191. Some companies complained to us that university departments lacked the facilities and equipment in some specialised fields necessary to simulate an industrial environment which made them unsuitable to carry

out contract work for companies. This was sometimes because departments had received gifts of obsolete equipment from companies and so were constantly out of date, rather than being able to acquire, and replace, modern equipment for themselves.

192. Most of the large companies interviewed said that they would not use university departments to solve their short-term problems in applied research or product development. Their own research laboratories or independent research organisations could do this more effectively, and they felt a wrong order of priorities lay behind the assumption that universities or Research Councils should be called on to 'solve the problems of industry'.

193. One reason suggested for the poor industrial orientation of some academics was that the peer review system in universities gave credit for academic papers written but was not as quick to applaud the commercial applicability of the work. Many variants of this argument were offered which had as their underlying theme the fact that academic values and priorities were different from those sought in research commissioned by industry, and the consequences of such disparities created constraints against the commercial funding of research in academic institutions.

194. One suggestion for improving the industrial orientation of university departments was the cultivation of 'centres of excellence' by which specific departments would be recognised as authorities in a particular area of expertise with appropriate capital expenditure: this would counteract the problem of obsolete equipment referred to above.

195. University departments were used extensively by some companies for consultancies. It was suggested that more universities should seek to emulate the Massachusetts Institute of Technology which operated a system whereby a fixed fee per annum allowed limited availability of any academic staff within MIT for consultancy purposes. In return MIT rewarded academic staff for such industrial contacts. The University of Surrey had initiated a similar system on a smaller scale, but this was relatively new and its success was as yet unknown. Individual consultancies clearly exist on a large scale in British universities, and have done so for a long time. There is clearly much scope for extending those individual links from which other forms of collaboration might grow. We believe that the scale of this research activity and collaboration between the universities and the industrial and business worlds is seriously under-reported and that more information is needed about it.

196. We referred, in paragraph 128, to the funding by companies of chairs or subordinate posts in university departments and colleges. These were generally in specialised fields where there was a perceived lack of government-funded posts. Few companies would now be prepared to endow a chair outright as this required too large an initial capital outlay. However, companies were evidently more prepared to provide financial support for a limited number of years in return for the general benefits resulting from the promotion of a particular field of knowledge and more particular advantage which closer contact with the relevant department might bring.

COLLABORATIVE SCHEMES

197. We found that the various collaborative projects between industry, universities and Research Councils were generally praised by companies, who agreed that the primary aim of boosting the overall level of R and D in Britain would best be served by the public and private sector complementing each other's efforts. This was an important conclusion to many of our discussions: any proposed substitution of private funds for public resources (particularly in 'basic' or 'strategic' research) would not be welcomed but if the basis for seeking increased private participation was collaborative much progress was possible. Collaborative schemes were important in increasing mutual understanding—especially by improving the industrial orientation of research in the academic world. They were of benefit to companies as they enabled them to move quickly into new areas without an irreversible commitment. They gave access to skills and facilities in known 'centres of excellence' in a cost-effective way. The contacts which were developed with the research community as a result kept companies in touch with latest developments and intellectually alert. Those companies participating in the schemes stressed that the level of involvement and the value to them was far greater than the raw figure of financial expenditure seemed to suggest. In addition the arrangements described below were examples of successful projects between companies and Research Councils/universities. Such collaboration did not necessarily involve financial transfers at all, although most instances did.

Joint laboratories

198. We were told that sponsoring a joint laboratory with a university would be an effective means of concentrating research which spanned several academic disciplines and hence was difficult to carry out in any one department. ICI had found this to be a particularly effective form of co-operation and had sponsored 3 joint laboratories: at Manchester for polymer science; at Liverpool for bio-engineering; and at Leicester for

molecular biology. The company had rewarded members of staff and provided money for research fellowships, equipment and some overheads.

ICIs Joint Research Scheme

199. ICI endowed novel research projects which interested both the universities and the company and which otherwise would not be funded. The selection was made annually by a joint ICI/academic panel. Between 1974 and 1981 about 70 projects were funded. During 1984/85 ICI expected to give grants totalling about £0.5 m: typically each grant involved current expenditure of £30K–£40K and £10K in capital costs. The scheme aimed to promote close working relationships with universities and transfers of staff were an important element.

The BP Venture Research Unit

200. The Unit has been set up to support university fundamental research in any fields which show promise of substantial industrial relevance within a decade or so. The Unit is flexible in its approach and is prepared to assist researchers directly or indirectly in a variety of modes of support. Assistance is normally restricted initially to a maximum of three years but can be extended. Awards are made to the university to cover the cost of the work including salaries, capital items, consumables, travel, services and overheads. The Unit is at present supporting 22 teams with a current budget of £1.5 m.

201. Given the level of enthusiasm expressed for these schemes there would appear to be scope for expansion as a means of attracting greater private funding for research. However, it was evident to us that a number of important caveats remained:—

- i. whilst collaborative schemes had the effect of boosting the total funds spent by industry on extramural research, they did not usually generate income to Research Councils or university departments;
- ii. the danger in most 'matching funds' schemes was that industry would favour projects towards the applied research and development end of the spectrum, which would mean that Research Council funds might tend to be diverted away from basic and strategic research. Appropriate complementarities need to be developed to maximise the common ground between Research Councils and university scientific priorities and the potential advantages to industry;
- iii. several of the larger companies said that they had their own research laboratories to maintain and would therefore be unreceptive to suggestions that they should channel more funds towards Research Councils in order to shield them from cutbacks in government funding;
- iv. the differing fundamental purposes of the collaborating parties might lead to conflicting views as to how a project should develop. It was not always possible to predict in advance the course of a research project and so, for example, academic scientists' intellectual curiosity might lead them down a different path from a company seeking commercial applications. Again, close liaison extending the appreciation of each other's approach was needed to minimise these divergencies;
- v. problems of confidentiality might arise when a collaborative research project reached the stage of commercial exploitation. This was particularly the case for pharmaceutical companies who would often ask for a 6 month delay from patent application before research results were published.

ATTITUDES OF COMPANIES TOWARDS R AND D BY INDUSTRIAL SECTOR

202. As we noted in paragraph 161, the most significant factor determining company attitudes towards R and D was the industrial sector in which they operated. We suggest that the reasons for the different attitudes include the following:

- i. existence of pre-competitive stages of research relevant to the industry: companies, such as pharmaceuticals, in industries which had virtually no pre-competitive stage, needed to be closely involved in basic research in their fields in order to avoid being left behind in the continual race to develop new products and processes when the time-scale of basic research through to commercial launch was relatively short;
- ii. technological content: in 'hi-tech' areas of industry such as electronics, it was vital for companies to maintain their commitment to R and D because in a market where existing products became outdated very quickly, to stand still was to be left behind.

203. The table below, based on 1983 figures, shows those product groups with the highest expenditure on intramural R and D.

TABLE 5:

1983	Total R and D Expenditure (£m)	R and D as % of Turnover
Electrical and Electronic Engineering	1,333.6	7.5
—telegraph and telephone apparatus	360.3	24.3
—radio and electronic capital goods	633.3	22.6
Aerospace Equipment	720.0	13.8
Data Processing Equipment	247.3	12.0
Chemicals	735.0	3.3
—pharmaceuticals	377.7	10.5
—other chemicals	357.3	1.9
Mechanical Engineering	249.6	1.0
Motor Vehicles and Parts	239.5	1.8

A more elaborate break-down of this information is given at Annex F(ii). It was pointed out to us that some double-counting may occur in these figures, and that the R and D of some larger firms would straddle various sub-categories.

Sources: British Business
Business Monitor

The chemical industry

204. The chemical industry was characterized by a relatively high expenditure on R and D as a proportion of turnover (see table 5). This, however, disguised considerable variations between pharmaceuticals (10.5%) and other chemicals (1.9%).

205. All of the companies approached by the Working Party had in-house research facilities, and several used these to carry out some basic research. Generally chemical companies conducted about 1% of their R and D extramurally; the figure for Unilever was about 3.5%, and the ratio would have been higher for other companies if they had included in their definition of research such work as clinical testing of drugs.

206. Of the chemical companies that we consulted only ICI appeared to have had much contact with Research Councils. ICI made substantial use of collaborative schemes with SERC and found these extremely fruitful. The company was keen to develop similar contacts with AFRC and MRC as their establishment contained some of the highest quality scientists. In recent years ICI had found the AFRC institutes whose work was closest to their research interests more flexible than had earlier been the case and close ties were also being developed with MRC. Another major company believed that MRC did not have adequate mechanisms to conduct contract research, and several companies noted the lack of industrial representation on MRC's boards. A third company, however, was discussing a potential joint research project at an MRC establishment and the fact that the foundation and development of Celltech was due largely to MRC initiative should not be overlooked.

207. All the chemical companies interviewed told us that the universities were the major external bodies they used for research. Types of research conducted and the purposes thereof varied considerably—ICI described their involvement in research in universities as broad rather than deep, the aim being to develop contacts with centres of excellence and to keep in touch with latest developments. Other companies said that their main purpose was to develop and maintain working relationships with individuals or teams known to have a particular expertise. The use of consultants from the academic world was particularly effective here. Some of the larger pharmaceutical companies sponsored pure research in universities but applied research and development was more common.

208. All the large companies made extensive use of the CASE awards scheme. In addition to the research results themselves, the scheme was a good means of developing contacts with universities. The smaller companies required research with more immediate commercial relevance and therefore made less use of CASE awards.

209. ICI expected to make about 30 awards in 1984/85 under the SERC Co-operative Grants Scheme. This scheme was based on ICI's own Joint Research Scheme (paragraph 199), and was considered extremely useful in developing industry-academic links.

210. Generally the chemical companies thought that the training of students was satisfactory for industry's needs and that graduates were well qualified.

211. Chemical companies seemed to have developed good working relationships with the universities and considered current arrangements to be quite satisfactory. They did not generally feel that much scope existed for increasing their funding of extra-mural R and D in this area.

212. All the chemical companies interviewed stressed that the conduct of basic research in Research Councils and universities was vital to their long term success.

Electrical and electronic engineering

213. This sector of industry accounted for the highest level of R and D expenditure both in absolute terms and as a percentage of turnover. All the companies interviewed sponsored some work extramurally but the total amount was low. One of the main reasons advanced to explain this was that much of the R and D was processor systems-orientated and considered unsuitable for contracting out.

214. Much of the R and D was development work; this was especially so in electronics where much work was customer-funded involving tailoring systems and products to suit specific requirements.

215. Of the work which was conducted extramurally, a large amount was done by professional contract-research organisations which were considered to be well geared up to meet the industry's particular needs in terms of availability of expertise and ability to work to tight time constraints and in strict conditions of confidentiality.

216. Contact with the Research Councils was low. Of the companies interviewed only 2, British Telecom (BT) and GEC, claimed to have close contacts with any Research Council (SERC). Other companies thought that the Research Council organisation was not geared towards the needs of this sector of industry and companies preferred other approaches in order to maximise their control over the use of resources and to orientate research to their own needs.

217. With one exception (principally working in the electrical field) all of the companies interviewed sponsored some research in universities. Occasionally this was pure research—in such fields as semi-conductor materials—but most of it was developmental.

218. With the exceptions of BT and GEC, relatively little use was made of the CASE awards scheme. However, many companies participated in the Alvey programme and Teaching Company Scheme which were important in improving links between higher education and this sector of industry.

219. BT and GEC appeared to spend more money on extra-mural R and D in universities and Research Councils than other companies in this sector, and both stressed that the value to the company of these contacts were greater than the cash flow appeared to indicate. They expressed deep concern at the financial pressure felt by universities engaged in basic research, which they considered to be a government responsibility.

Mechanical engineering

220. Expenditure on R and D as a percentage of turnover was low in this sector (1%) but because of the size of the sector the absolute sum was significant. Companies in this sector had little interest in basic research. Nearly all R and D expenditure was in-house.

221. Many companies told us that present university structures and attitudes were such as to make increased industrial involvement unlikely. Engineering companies were not interested in small, specialised pure-science departments which were insufficiently orientated towards the commercial world. They also felt that the departmental specialisms through which departments of engineering in most British universities were structured were not best suited to respond to the needs of research and development of their side of industry. Teams from different university departmental specialisms, including science departments other than engineering, were usually required for such research in a field of manufacturing or into systems. Research in engineering departments will be more 'mission-oriented' and less 'basic' (in the sense of not being related to potential utilitarian applications) than in other scientific disciplines. Hence there was a need for 'directed research', which was multidisciplinary and integrated specialisms towards economic applications with some consequent restructuring of university engineering departments. We suggest that university departments should consider these new approaches in consultation with industry. It was suggested to us in this connection that these issues also touched the SERC in its support of engineering and that more attention might be paid to providing project management support for multidisciplinary directed research and development.

222. One engineering and electrical/electronic company—Lucas—said that universities did not find out what industry required in its recruits into engineering and management roles and in consequence the company had to spend its own time and money on retraining new recruits. An exception was made in the case of the university of Warwick, with which the company was developing close relations. In their view to attract

engineering postgraduates required higher salary levels than appeared to be the case with postgraduates in pure science.

223. In view of the comments made we think it only fair to add that it was recognised that SERC's efforts in engineering had increased and that initiatives such as the Teaching Company Scheme, the High Speed Machinery Programme and the Directorates were considered to be very useful.

Conclusions

224. Our main conclusion is that basic research—at least that which is perceived not to have 'strategic research' potential—is clearly seen by industry as a prime Government responsibility. We found no evidence to suggest that Government would have prospects of success in persuading industry to increase its funding of such work in Research Councils and universities, where this was unrelated to the interests of industry. It was made plain to us that a general condition for any additional funding by industry of research in universities and Research Councils would be that such funding must be additional to, or complementary to, existing Government funding, not a substitute for it.

225. We are satisfied that there is no likelihood of significant additional 'philanthropic' funding of research by industry, beyond its present levels; that is to say of research which is not orientated towards potentially profitable results. Companies' research budgets are allocated against clearly defined criteria of which the most important is a looked-for contribution to a commercial return within a specified pay-back period.

226. It is clear to us that, as far as industrial companies are concerned, collaborative schemes in many different modes constitute the area in which contacts between industry, universities and Research Councils are most beneficial and in which there seems to be greatest potential scope for expansion and increased private funding, apart from contract research. This will become, in our view, a critically important 'triple alliance'. We consider that this is the area in which relations and understanding between industry and the academic world have improved most in recent years, through such schemes as the Teaching Company, Alvey, CASE awards, and Co-operative Awards. Companies consider that there is scope for expansion of such schemes which are seen as particularly effective as they involve the public and private sectors complementing each other's efforts. At present companies in some sectors, for example chemical companies concerned with materials research find it easier to maintain contracts with universities than the engineering companies with wide multidisciplinary problems to solve.

2. BANKS AND VENTURE CAPITAL INTERESTS

227. The rate of growth of venture capital in Britain over the last five years had been rapid; there were thought to be over 90 such companies at the end of 1984 compared with about 20, only five years ago. This situation, in conjunction with the emphasis in government policies towards small companies and incentives to encourage entrepreneurs, led us to expect that this might be an area from which sizeable additional funding might be forthcoming and so we included in our programme of interviews discussions with representatives of banks and venture capital organisations.

228. All of the companies we approached stressed the importance of basic research in generating the applied research and new technologies of the future. However, it was made plain to us that venture capital companies would fund this type of activity only in very rare cases; they considered it to be a Government or large company responsibility.

229. We were told that the British Venture Capital Association had some 60 members, of whom it was thought that less than 10 were prepared to fund even applied research. This was considered to be uncommercial. The long timescales and infrequency with which a 'commercial' product emerged produced too small a likelihood of earning a commercial return on the money invested. Potential funders had to view proposals against normal commercial criteria; such constraints included the conservative policies adopted by pension fund managers. Venture capital firms were essentially promoting the establishment and development of new or relatively new businesses in an untried and therefore high-risk market environment, rather than sponsoring research in a pre-commercial context.

230. We therefore tried to establish at what point along the spectrum from basic research to commercial development venture capitalists would step in. Attitudes varied in this respect. Midland Bank Venture Capital (MBVC) who had funded at least one R and D project said that the greatest problem lay in the transition of a project from the laboratory to the commercial world. For a project to be commercially successful it was necessary to design the product to meet the implications and requirements of the market place right from the start, and experience had shown that, where commercial factors were not fully allowed for at the formative stage or fairly soon after, the product had an unacceptably low chance of success. The individual product had to be 'market led' specifically, even if the general field from which it sprang was explained by 'technological push' arising from the advance of scientific knowledge. The academic world, in their view, under-

standably lacked business 'gut feel' and general commercial knowledge. It was essential to develop business skills in the fledgling management team, and in those associated with it, right from the start. Experience had shown that it was not satisfactory to substitute for this lack of knowledge by placing an experienced businessman alongside the would-be scientific entrepreneur; the need was rather to find a good entrepreneur who already had, or who was able rapidly to acquire, the necessary business sense. Given the right environment, however, the necessary knowledge took weeks or months, not years, to acquire. MBVC's experience was that success depended much more on the individual people involved than the product.

231. Prutec, like MBVC, preferred to invest in small companies at an early stage in the development of high technology products. However, they were untypical of venture capital organisations in that they also invested in research projects, mostly by way of contract research companies, but also currently in 6 universities and one AFRC institute. The aim of this was to make a project attractive to industry by reducing the technical and financial risk involved.

232. Equity Capital for Industry (ECI) did not generally seek to become involved in the early stages of research because this was not commercially viable; the hope was that they could successfully join in at the exploitation stage.

233. However, most of the companies said that although they would not directly sponsor the initial stages of research, they were keen to find new ideas to exploit and therefore sought to develop active contacts with universities and, less commonly, with Research Councils where commercial awareness existed.

234. Investors in Industry (3I) told us that the principal activity of their organisation was to finance companies, not research or other projects. As they saw it, the purpose of the company was to provide the means of exploitation of an idea, perhaps born of university research. This was a long way from the pure research end of the research spectrum but 3I emphasised to us that they were keen to find ideas to exploit and they sought to keep a relationship with universities, usually in an informal way, involving very often the science parks or collaboration with university companies. Since the BTG licence was abolished 3I had been thinking about new modes of liaison and had devised a new arm to work closely with universities in helping them to develop new ideas. They hoped, we were told, to develop this to assist more effectively with making ideas into commercial propositions by other means, such as contract research, perhaps involving the pilot stage. 3I had had some talks with Research Councils but had not achieved any firm developments and wondered whether institutional blockages and different objectives and assumptions currently inhibited effective collaboration between the Councils and venture capital interests.

235. The experience of 3I seemed to be general. Of the companies which we interviewed only one had a contract with a Research Council; this was Prutec who had sponsored work on biotechnology in an AFRC institute because of the expertise which they had to offer. Contacts with universities were more widespread and varied but several companies thought that involvement should, in principle, be much larger since there were plenty of good projects in these institutions. MBVC said that commercial support for an individual or a research team in a university department depended in large measure on the 'chicken-and-egg' situation of whether they already had an established track record of proven commercial success. This necessarily had to be the main criterion; investors would normally be willing and indeed actively seeking to back teams that had already produced one or more commercial successes but untried newcomers, of necessity, had to be considered with extreme caution.

236. Prutec said that they might use a university to complete a project begun with a research company, or carry out testing of a prototype when it was known that specific expertise was available and that it would be significantly cheaper to proceed in this way.

237. We tried to ascertain what were the constraints which prevented venture capital companies from providing more support for research in universities and Research Councils. The following reasons were given: —

- i. universities and Research Councils lacked commercial awareness (see paragraph 230);
- ii. vacation breaks and teaching commitments coupled with the lack of commercial awareness meant that university departments were less likely to appreciate and meet the rapid response needs of commercial requirements;
- iii. there were problems concerning exclusivity and confidentiality when it came to publishing results of commercially exploitable research projects;
- iv. universities and Research Councils generally had inadequate mechanisms and contacts with industry to bring commercially promising ideas to the market place;
- v. the prevailing culture in British universities was not orientated towards wealth creation to the same extent as it was, for example, in the United States.

238. ECI suggested that specially established university 'interface' companies were an effective means of aiding commercial exploitation of research results, and might provide a surplus for part of the profits to be fed back into the finance of basic research. One version of such a company might be a 'club' arrangement whereby several investors—such as venture capitalists, investment trusts and merchant banks—would underwrite capital costs for a specified period of say four to five years. The university would have a controlling position in the management company but not in the individual projects which it supported.

239. Some companies said that they expected to work to a timescale of around 7 to 10 years for positive returns from commercial exploitation. MBVC said that the objective was to create a strong and well organised company capable of self-sustained growth over many years rather than to realise a specific return after a given period. Whilst the company was becoming established it needed to be funded with equity but, if handled properly, should thereafter be capable of being able to grow, relying very largely on normal commercial bank and other facilities.

240. The areas of scientific research which venture capital organisations had funded recently included biotechnology (plants and animals), electronics software, optics, applied robotics, new materials, industrial automation, application of microprocessors and instrumentation. University companies seem to provide a suitable organisational structure for collaboration with venture capital organisations (possibly a pre-condition for such collaboration) and we consider this to be an important path for the growth of collaboration between universities and the business world for the exploitation of research, if not directly for the funding of research itself in these fields. As universities tackle the problem of setting up appropriate organisational structures for this purpose we think rapid expansion is likely. Through such structures a 'context of enterprise' would also be encouraged.

241. Our conclusion is that most banks and venture capitalists in all but very exceptional cases considered the risks are unjustified because the chances of commercial success are too small and uncertain as far as backing research is concerned, and are more orientated to development capital than to equity finance for start-ups. They prefer to invest in existing small companies dealing with known technologies and products rather than research projects; none would be likely to sponsor basic research and very few applied research. An exception in such a generalisation must be made for Celltech. We conclude that there would be no likelihood of generating a 'bandwagon' effect in isolation or globally of funding research in universities and Research Councils from this sector; it would be a question of attempting to match particular sources of investment with specific research projects. In particular contexts—in science parks, high technology specialisms and where universities were well organised to face outwards towards industry and banking—much could be done. We again note, however, that the 'Cambridge Phenomenon' is a successful commercial consequence of research rather than a producer (at present) of important feed-backs of funds into university research.

242. We believe that an effort ought to be made to construct more effective bridgeheads between the academic community and the Research Councils on the one hand and, on the other, the banks and venture capital interests. We are not sure how this can best be done and there may be scope for further studies, not necessarily under ABRC auspices, to see what can be done to overcome the evident reluctance of the venture capital and other city interests to put more funds into academic and Council research. This means essentially that the prospects of commercial success for such initiatives need to be improved. What information we have about overseas practices suggests that in the different context of North America, certainly, venture capital is much more freely available for research and development purposes. We have read—and see force in the allegation—that one of the reasons for Britain's disappointing economic performance is a reluctance on the part of holders of funds to assist academic research and small businesses in the present context of commercial risks. We imply no special criticism of the venture capital interests which may, in the British scene, have good reason for their caution. Commercial backing for research requires commercial appreciation by promoters of research. Without more appreciation of this it is hard to see what specifically can be done to remedy this situation but we think that universities, whether individually or in regional groups or through the aegis of the CVCP, should extend the awareness of business requirements and establish contact with venture capital interests to explain what they have to offer and to seek to dispel possible misconceptions. Effective internal re-organisation is a pre-condition for this. There must be some scope, too, for a similar initiative on the part of individual Research Councils although we consider that the prospects of the Councils obtaining large amounts of funds from venture capital interests are not great.

3. THE CHARITABLE FOUNDATIONS

243. In considering the role of the charitable foundations it may first help to set the scene by quoting some overall figures. The latest returns from the Charities Aid Foundation show that the biggest 200 UK charities had an income in 1984 of £956m, a 17% increase over the previous year. The figure, of course, refers to charities of all kinds including those, such as Oxfam, which fund relief operations mainly overseas. There is also a multiplicity of very small charities directed to particular objectives often of a local or specialised

character. Most of such bodies do not fund research in any significant way. Indeed most of the charities do not come within the scope of this study and those which do—at least on a significant scale—are, we suggest, relatively few in number.

244. The charitable foundations which support scientific research in universities are diverse but the most significant single group comprises those whose remit is specific to the medical field. In addition there are those which have more general terms of reference, but which include medicine. In this category come the Leverhulme Trust, The Nuffield Foundation and the Wolfson Foundation. As the field of medical research is unique in the total extent and relative significance of the contributions from charitable foundations, we have concentrated on this aspect of their funding.

245. So far as the medical charities are concerned, the total income of the 35 members of the Association of Medical Research Charities (AMRC) in 1983 was £128m, of which nearly £77m was spent on research. This has to be compared with the £106m dispensed in that year by MRC (of which the universities received £26m). The relative importance of non-Research Council grants in medical research can be seen in relation to the undergraduate and postgraduate medical schools of the University of London. In the academic year 1977–78 research grants from the Research Councils totalled £3.7m and research grants from other bodies (principally the charitable foundations) £8.2m.*

The largest funders within the Association were:

Table 6:

	Income £m	Charitable Expenditure £m
Arthritis and Rheumatism Council	5.8	5.1
British Heart Foundation	7.5	7.7
Cancer Research Campaign	19.1	18.1
Imperial Cancer Research Fund	22.1	15.7
Leverhulme Trust	3.9	4.5
Multiple Sclerosis Society	4.7	5.2
Muscular Dystrophy Group	2.1	1.7
Nuffield Foundation	2.8	0.80 (Science, medicine and rheumatism only)
Spastic Society	22.5	22.9
Wellcome Trust	20.0	20.0

246. Expenditure on medical research by members of AMRC increased by 55% in real terms between 1976 and 1983, including growth of 4.1% over the year 1982–83. We understand that the recently announced financial changes in the Wellcome trust are likely to double the Trust's annual income by 1987.

247. In our discussions the directors of three of the major foundations (one of them also, by agreement, representing the AMRC) were unanimous in emphasising that they saw their role as being wholly independent of that of Government.† The foundations did not wish to support areas of research which were the main commitments of the Research Councils and considered that the charities had a separate but complementary role to play in which their diversity and flexibility were acknowledged as being extremely valuable. The essential thing was that the foundations aimed to supplement public funding of research and so had maintained a policy of not channelling funds directly through Research Councils. They were highly resistant to any proposal that might seek to attract funds from them as a substitution of private for public funding and were emphatic that they would not wish to take actions which might encourage the Government to withdraw from what they saw to be its responsibility for the funding of basic research. The foundations were concerned lest they should be regarded as a convenient funding source for plugging gaps caused by Councils withdrawing from particular areas due to a lack of funds. On the other hand they saw increased scope for collaboration ventures with MRC, within the context of research programmes which were university-based.

248. The foundations explained to us that they provided extensive support for research in universities. The Wellcome Trust spent £19m on medical and veterinary research in 1984–85. The Trust's major support is in response to ad hoc applications but it also selected certain fields of medicine for particular attention

* Flowers Report on Medical Schools of the University of London (Appendix V, p 78)

† The Research Director of the Imperial Cancer Research Fund, Sir Walter Bodmer, was a member of the Working Party.

because it believed that by giving them special support, knowledge would be increased in relatively neglected areas such as tropical medicine and mental health. The trust also provided special fellowships in clinical science, surgery and pathology etc. The programme of Wellcome Senior Lectureships in medical sciences had continued to provide extra posts for high quality research staff in universities. The Trust also gave grants for equipment and occasionally for buildings often on a matching grant basis from other sources. Significantly, the Wellcome Senior Research Fellowships in basic bio-medical sciences had at one time been discontinued as awards available from the MRC and SERC provided support in this field (they have now been revived). The Wellcome Trust, like other Foundations, would not normally make funding commitments beyond 5 years to a university department as this would amount to 'core' funding which the Trust considered to be the responsibility of Government. In addition they said that since it was not always possible to predict the research priorities of a department several years ahead, long-term funding would reduce flexibility. In consequence the Trust preferred to support researchers or subject areas rather than departments as such. However medical charities, the Trust included, have been instrumental in effective long term support of academic activities and research through the endowment of chairs and associated posts. The Trust plays a particularly significant long-term role in the continuing involvement of British Universities in studies of tropical medicine both at home and abroad.

249. The Nuffield Foundation made grants totalling over £2m in 1983 of which £0.65m was spent on science and medicine. The Foundation, like the Leverhulme Trust, also funded research in the social sciences and education and spent a substantial proportion of its funds on activities which did not involve research. The Trustees would support proposals of originality and promise which met with the Foundation's general objects of the advancement of human health and well-being. As a result of a recent policy decision the Trustees would no longer consider research grant applications which were eligible for Research Council support or which had already been considered by a Research Council. The Foundation currently spent about half of its Science and Medicine budget on three special schemes: small grants of up to £2,500 to support innovative research; one-year science research fellowships to provide a year's relief from teaching for young university scientists; and awards for newly appointed lecturers (up to £4,000) to help in the early stages of their independent research careers. The Foundation also currently spent about £300k per annum in support of ad hoc proposals in science and medicine; grants in excess of £50k were made only rarely.

250. The Leverhulme Trust had an income in 1981 of £3.7m, which was used to make grants of £2.6m to institutions and of £350k to individuals under schemes administered by their Research Awards Advisory Committee. In the fields of medicine and natural sciences, the Trustees' policy was not to finance projects eligible for the funds of the Research Councils and more specialist foundations. Examples of research supported by the Trust included three year research fellowships at the University of Surrey into toxicity testing; a three year research fellowship and assistance at the University of Cambridge for research on rural health services in Papua New Guinea; and a four year research fellowship for research on molecular beam epitaxial techniques and applications at Hatfield Polytechnic.

251. We were told of several examples of support for research in universities on a collaborative basis and the foundations emphasised that they thought this to be a mode in which they saw scope for expansion. The Wolfson Foundation had provided £1m for buildings to house research on molecular medicine in Oxford and the Wellcome Trust had provided equipment for the MRC molecular laboratory in Cambridge.

252. Although, as already noted above, the foundations would not give funds or equipment directly to a Research Council they would consider supporting research programmes in a university department in parallel with Research Council funding. The fact that a large amount of MRC-supported research occurred in university departments, as opposed to in-house establishments, made collaboration with that Council easier than with other Councils.

253. It was explained to us that some of the foundations has also been involved in collaborative ventures with industry. They would not give funds directly to the company concerned but might fund a university department to carry out a research project in partnership with the company. In this case the foundation might provide a grant for a specified period, but there would always be a cut-off point after which the industrial company or university would take it over completely. Where that cut-off point lay was a nice decision which had to be taken in respect of each individual project. Because of their charitable status, the foundation could not support research which would be of direct commercial benefit to a company.

254. The charitable foundations made it clear that they did not use potential profitability as a criterion for deciding whether to support a research project. However, the Wolfson Foundation were concerned that the project must be able to demonstrate potential benefits to society in some way; for example their medical research was 'patient-orientated' and was required to demonstrate the clinical benefits which might ensue. In their support for non-medical research also the Wolfson Foundation had more 'entrepreneurial' aims than the others. The foundation has a very well-established and respected technological projects scheme for the support of university research where there is an application in suitable areas. This scheme had its origins in

the recognition that, if industry was to benefit from the scientific talent in the universities, the gap between higher education and industry had to be bridged as a matter of urgency.

255. The time-scale involved between basic research and commercial application was much shorter in the area of medical research than in many others. Most of the foundations were very active in this area; the Wellcome Trust expected to spend about £25m on bio-medical research alone in the next year, and £40m in the following year. It was made plain to us that the foundations considered that the amount of public funds spent on medical research was woefully inadequate when compared with the resources provided by the charities and pharmaceutical companies; MRC contributed only about one third of the total UK research effort in medicine. The foundations considered that the MRC could not therefore claim to represent the total national effort in this area and this underlined the lack of a suitable forum in which the MRC and foundations could meet as equals to discuss important matters of national policy. It was suggested that a body analogous to the UK Cancer Co-ordination Committee was required to facilitate consultation without jeopardising the independence of the foundations, or encouraging any diminution of public funding. We support this suggestion and understand that the MRC also welcomes it and sees a valuable role for consultation and collaboration between the Council and the charities, whilst fully acknowledging the independence of the charities and the importance for the progress of research of the presence of multiple and independent sources of support. However, the Council has pointed out to us that there is already good co-ordination in the fields of cancer research and heart disease and it would like to hear further from the foundations what the latter have in mind. We urge the MRC and the charitable foundations to institute discussions for such wider co-operation.

256. Finally, the Directors we met gave us their view that the present taxation structure did not encourage private funding of research to the same extent as in the USA, as donations made by individuals could not be offset against income tax unless they were covenanted.

257. Our conclusion from meeting the three directors and from considering other evidence made available to us is that there would appear to be some ground for looking to the major foundations for increased collaborative funding in the medical field but only in certain circumstances and, overall, to only a limited extent. It is clear above all that the foundations would need reassurance that Government was not looking to them to assume responsibility for meeting basic research needs and was not seeking to entice the foundations into the formal Governmental funding mechanisms for such research. We respect the determination of the foundations to retain their independence, flexibility and diversity.

TAXATION

258. At the start of the study we expected that those who put evidence to us would lay considerable emphasis on the impediments placed by the tax structure in the way of a greater flow of private funds to the Research Councils and higher education.

259. The CVCP Burnett report and the UGC strategy document had both urged that taxation concessions were desirable, the former emphasising that American corporations were allowed tax advantages on contributions up to 10% of pre-tax profits whilst the UGC advocated changes in the tax laws to make single covenanted donations more attractive and to relax the restrictions on the setting of corporate gifts against corporation tax. We were aware that Ministers in the spending departments had raised the subject with Treasury Ministers in 1983 and again in 1984 with particular reference to the possibility that firms might be afforded greater tax incentives to support higher education, especially through donations of equipment. The Treasury view remains that comparisons between national tax structures are misleading and that, taken as a whole, the UK arrangements are not less favourable than the American and that UK tax concessions in respect of donations for higher education are already advantageous.

260. The 1985 Budget contained provision for the extension of a 100% scientific research allowance, despite the phasing out of other incentive capital allowances. The Business Expansion Scheme was also extended to research and development companies.

261. In the event taxation received only a minor emphasis in the evidence put to us and then the point usually addressed was the matter of tax concessions for individual private donors who, it was widely agreed, were less well placed than their American counterparts. The British and multi-national company representatives we met attached little importance to the taxation aspect, saying that other considerations were more significant in causing a company to decide whether or not to steer funds to higher education or the Research Councils. Such research funding related to a company's commercial activities (as distinct from more general benefactions) was a straight write-off from income and hence escaped corporation tax. However, amongst the technical accounting and tax considerations which have been put to us as meriting further study, is the apparent difference between the British and US positions over the role of short-term research partnerships and 'off balance sheet' funding of research.

262. Such are the detailed technical complexities of tax systems that we are by no means fully satisfied that there is not a worth-while case to be made for more generous tax concessions to encourage individual and corporate donations (as distinct from research spending), but in the time available to us we have not been able to pursue this specialised subject. We suggest that the universities in particular should renew their representations and that, given its professed desire to encourage private funding, Government should be willing to re-examine the possibilities in an open-minded way. Such an investigation would require detailed professional consultancy.

Part 4—Our general conclusions

263. One point was made to us with great emphasis by many of the witnesses whom we met or who submitted written evidence: industrialists, city interests, Research Councils, academics and staff associations offered us a variety of often conflicting views on other aspects of the study but on one matter they showed general agreement. This was that it would be wholly wrong for central Government to seek to divest itself of much of its present responsibility for the funding of basic long-term research in the universities, local authority colleges and Research Councils and to look instead to industry and commerce, the charitable foundations and wealthy philanthropists to meet part of this need. The industrialists we met considered that they already contributed through the tax system to the funding of higher education and research and they saw no justification for an attempt by Government to lay an additional burden upon the world of business in order to reduce public expenditure. Such an attempt, in their view, would prove counter-productive as well as being wrong in principle. They felt it essentially right that Government should retain the principal responsibility for securing the national teaching and basic research capability in its higher education institutions and Research Councils. A clear division of responsibility was perceived in which business looked after that part of research which lay at or near the commercial end of the R and D spectrum with industry, higher education and the Research Councils overlapping in the middle sector where basic research shaded into strategic and applied. A different strategy might also be appropriate for engineering departments in universities and polytechnics than for 'pure science' departments.

264. This view was substantially endorsed by the academic community and by the Research Councils. Both laid great stress on the need for a reaffirmation by Government that it would continue to provide an adequate funding floor for higher education and for the Science Budget as an acknowledged national priority at a time of economic stringency. It was argued to us very forcibly that it was a false economy to seek to reduce public expenditure in these fields, that Britain's future prosperity depended on adequate levels of funding now and that it was in any case wholly appropriate for central Government to assume the main responsibility in such matters. Our interlocutors from the larger companies argued, as the ABRC itself has argued, that it was a false dichotomy to see applied research, new technology and product development standing independently of basic research. Switching resources away from fundamental and strategic research would threaten the entire research effort of the nation, together with new technological possibilities, in the longer run. In an increasing number of fields, we were told, the nexus between fundamental and applied research was getting closer, (indeed that this nomenclature implied a meaningless dichotomy in a growing number of research fields), and that time horizons between the different ends of the research spectrum were narrowing.

265. The representatives of the charitable foundations expressed similar views. They saw their role as being that of an independent second force, complementary but not subordinate to, or in substitution for, Exchequer funding. The foundations made it abundantly clear to us that they would continue to expect adequate government funding for the Research Councils and higher education with sufficient resources to provide the necessary floor for basic research. For their part the foundations would look for funding opportunities in situations where, for various reasons, public funds could not easily be applied.

266. With these emphatic views went an evident distrust of the motives of Government in seeking to encourage a greater measure of private funding and a feeling that Government was trying unrealistically to put the clock back to the pre-war situation when Exchequer funding for both higher education and for the precursors of the present Research Councils was at a much lower level.

267. Apprehension about the intentions of Government was also evident in what our witnesses had to say to us about the financial framework within which institutions were being encouraged to seek more private support. The Research Councils in particular were uncertain as to the extent to which they would be permitted by Treasury to retain sizeable additional funds from non-exchequer sources. Councils suspected that, if they had great success in attracting significant amounts of outside funds Government would seek to reduce the size of the DES Science Budget. In their view devotion of effort to the objective of attracting private funding would constitute a wasteful diversion of valuable staff and other resources if Councils were required to surrender to the exchequer a significant part of the extra funds brought in or had their Science Budget allocation reduced by a significant amount. It was questionable, they felt, whether the Government's commitment not to penalise universities and polytechnics for success in attracting private support would be fully applicable to the Research Councils.

268. In the context provided by the views summarised above our general conclusions are these. We fully endorse the view that Government should continue to shoulder the main responsibility for the funding of higher education and the Research Councils. We think it essential that Government should clarify its attitude

to private funding and should in particular make plain what its policy is over retention by institutions of the private funds brought in. We greatly hope that such a policy will be a liberal one which will make it worthwhile for Research Councils, like the universities, to expend effort in seeking the alternative resources in the first place. Similar considerations apply to retention of income by the polytechnics. In other words we hope that Government will accept that private funds secured by higher education and the Research Councils can be regarded as being in large measure additional to and not in substitution for Exchequer grants. In this connection we would also hope that there could be some relaxation in government accounting procedures, particularly those relating to 'annualisation' of budgets and spending.

269. Much of this report consists of the views which were expressed to us by the representatives of different groups concerned either with the funding or the conduct of research. Such views were not held lightly and we pressed our discussants about them in the many interviews which we and Miss Jones conducted. They form, therefore, an important starting point for any attempt to formulate an integrated policy for the funding of scientific research, and they reveal a wide gap between the potential private funders of basic long-term research and the institutions—Research Councils, universities and polytechnics—who are pursuing fundamental research as to the potential for private funding. Both sides were pessimistic. We respect these views and are convinced that public funding must remain responsible for most of the inputs into basic research. This will be particularly true for research fields which are very expensive, demanding large-scale indivisible investments, and which do not have foreseeable, potentially profitable, results, in less than the very long-term. High-energy particle physics and astronomy are the most prominent examples of such research fields.

270. However, as we note earlier in this report, we think that these views, which represent prevailing opinions of the current situation, may be too negative—or at least too absolute—and are perhaps based on perceived present and past positions rather than future possibilities, or even much present reality. We do not believe that the spectrum of research should be seen as a dichotomy between longer-term 'basic' and short-term applied research—at least in many fields—operating in discrete compartments, leading independent lives and demanding totally different funding. We believe that the research scene is much more articulated, with dynamic relationships between much—but not all—fundamental research with a strategic orientation, promoting, through a dynamic of its own, over time, programmes with close relationships to the private sector. In such strategic research we believe that many possibilities for co-operative funding exist, with public and private funding playing complementary roles, participating in different proportions at different phases in the evolution of such research programmes. Such common ground may widen in the future in a growing range of research fields, to the advantages of all parties—research community, the public and the private sector.

271. Much needs to be done if such potential gains are to be captured. A pre-condition for such co-operation is much greater awareness of, and better knowledge about, the needs of both industry and the research community and the way in which both work. This is a reciprocal obligation, which the gap revealed in the perception of one party by the other in our interviews has emphasised. It needs to be pursued at all levels, and we consider that the main initiatives will need to be taken by the research community. An important 'information gap' has to be filled.

272. For several centuries there has been a two-way pull between advances in scientific knowledge and progress in technology. Scientific enquiry was stimulated by the need to understand and explain empirical techniques; new technology progressed from the harvest of scientific knowledge. The inter-relationships were complex and dynamic. Although in the later twentieth century it is usually argued that the trend has increasingly been towards technology gaining from science rather than the reverse, the relationships remain dynamic in both directions and are not to be understood in terms of a simple, direct, linear and one-way causality. It is for this reason that the community of scientific research and the constituencies seeking profitable new technology are both best served by close awareness of each other's concerns and by close contacts at all levels. Both groups, although their priorities and motivations may differ, share substantial common ground and both can gain, without subverting their own objectives, from such interactions.

273. Awareness of the needs of industry and the likely direction of advance towards practical developments can alert research scientists about areas of strategic research and the possible patterns of progress for fundamental knowledge. When conceived with such perceptions in mind fundamental research may have a higher propensity to prove more 'strategic' in its orientation. Equally the industrial community may gain if it is more aware of what basic advances in scientific knowledge are in progress in the universities and the Research Councils. During the course of fundamental research programmes 'spin-offs' may become apparent. Being in touch with research teams at the frontiers of scientific knowledge will encourage alertness to the implications of the directions in which research is moving. The regular interchange of personnel will help such awareness in both directions.

274. Improving joint awareness between the research community and industry is also partly a question of formal information and we recommend the creating of data bases at various levels to close this gap. It is

also a question of personal contacts. We realise that the universities are taking a wide range of initiatives in this regard for 'clubs' of different sorts, open days for laboratories, news sheets and registers of research for circulation—even to a series of Vice Chancellor's breakfasts for local businessmen. Initiatives could also originate from the side of industry. Awareness of the range of such possibilities will itself lead to their extension. At a more institutionalised level, collaborative research programmes, research clubs, the CASE and Alvey schemes, the joint funding of laboratories (with the joint discussion of the research programmes of such laboratories) and secondment of staff both ways will produce more sustained contacts. Particular attention will be necessary if smaller firms are to participate in such schemes.

275. This is not a plea that universities and Research Councils should 'sell out' to industry, convert their research facilities and divert their staff just to service the short-term needs of business. We were told several times by the Vice Chancellors and the Research Council representatives that, where research contracts were sought for their financial returns alone, where they were not pursued within the research priorities of the institute or did not grow out of the research interests of the departmental laboratories concerned, then academic and scientific standards were likely to be quickly compromised. On the other hand where collaboration was based upon shared perceptions about the utility of the research, from the awareness of its scientific priorities on the one hand and its eventual commercial possibilities on the other, the creation of common ground could be most fruitful for both sides. The more the research community and industry can be made aware of such common ground the greater will be the flow of private funds, and the greater the collaboration with 'core' public funding.

276. In the earlier part of this report we have offered some indication of the extent to which we think institutions are likely to be successful in attracting alternative funds. In summary our views are these:

1. The Research Councils

277. It is for individual Councils to decide how commercial they wish to become. We think that Councils may have some scope for increasing their income from research contracts, from sale of facility time to industry and from the marketing of internationally saleable services. We do not, however, believe that the amounts of extra funds so secured will, in the short run at any rate, be very great (such income will build up gradually) and we think that many of the benefits to be derived from greater collaboration with industry will be of a non-pecuniary kind. We see little or no prospect of Councils deriving a worthwhile amount of additional resources from unencumbered donations, fund-raising appeals, lettings or course fees and the like. We do see considerable scope for joint funding between the Research Councils, the universities/polytechnics and industry.

2. The polytechnics and other local authority colleges

278. We suggest that the local authority colleges should attempt more in the way of fund-raising on the pattern more familiar in the universities although we are unable to form an idea of the amount of money which might come in by such mechanisms. We would like to see college staff given more institutional backing and other practical encouragement by governing bodies and maintaining authorities to develop collaborative links with industry. They would be further encouraged if Government were prepared to institute a limited matching funding scheme on the lines of the proposal of the Muir Wood report in 1983.

279. That said we remain uncertain as to the extent of the prospects for the non-university sector in terms of alternative funding and we reiterate that the colleges are entitled to look to central and local Government for enhanced public funding if they are to develop their research capacity.

3. The universities

280. Of the three main institutional groups considered in this report the universities are by a long way the most experienced and successful in seeking alternative sources of income and they seem likely to remain so. Despite the institutional blockages noted earlier in this report the universities seem to have already achieved a fair measure of success in generating additional income and to be in a position to progress still further. We see scope for increased remunerative collaboration with industry by means of university companies and R and D 'clubs' and perhaps—although we have reservations—by means of science parks. There may be some scope—although not, we think, a great deal—for increasing the amount of revenue from such well-tried sources as overseas student fees, lettings and continuing education, which, by internal redistribution, might relax constraints on research funds.

281. There should certainly be plenty of scope for more academic fund-raising, perhaps of the intensive and sustained kind familiar in the USA. Well organised fund-raising campaigns may well offer some of the best prospects for institutions which have not previously had to resort to them and have some readily identifiable objectives to promote. It remains, however, to be seen whether British institutions can develop

a pattern of continuing alumni support on the American model or can attract the huge private or corporate donations which American colleges often enjoy. Contract research from industry is likely to be by far the greatest non-government source for directly providing research funds.

282. We agree with the Chairman of the UGC that, while there is scope for pursuit of more alternative funds, it would be unwise of Government to set targets of general application and we think that some universities would have difficulty in, for example, raising as much as 10% of their total income from private sources (this being a figure suggested at one stage by Ministers as a goal for universities to aim for). Doubtless this percentage will vary greatly according to the departments and facilities concerned (as will the costs).

283. Quite apart from the realism or otherwise of the prospects for obtaining significant alternative income we have noted earlier in this report our reservations about the desirability of all universities adopting a uniform approach to maximise their earnings from outside funds. In this connection we are aware of the differences of view within the academic community on the place which commercial contract work at the applied R and D end of the research spectrum and other forms of industrial collaboration should have in a university and we have sympathy with the view that such work should not be allowed uniformly to predominate or the search for it to distort scientific priorities held in the departments. In our view the university scene should retain its essential variety in which those universities which have a technological slant and a location well-suited to industrial contacts should be free to develop their collaborative work but in which other universities would follow different paths without any requirement to conform to externally-imposed 'norms' of alternative fundraising. We do not think that the aspiration for Nobel prizes should be forfeited for research contracts by British universities—indeed we refuse to see these objectives as mutually exclusive and believe that the most successful and prestigious universities, in this country as elsewhere, seek both objectives.

Part 5—Recommendations

1. The enquiry conducted by this Working Party was as much a fact-finding and opinion-exploring exercise as an investigation designed to produce recommendations. The information contained in the body of this report thus fulfills one of our main purposes.
2. In making recommendations we are also conscious of the fact that, in some cases, what we advocate may already have been implemented by individual institutions. The Research Councils and universities and polytechnics are urgently reviewing the range of possibilities for increasing their non-public funding. As we have mentioned in the body of the report, one of the principal means of improving performance is not so much through making wholly new innovations as through more widely diffusing the current best practices which are already to be found established in individual instances. The recommendations which follow carry no implication therefore that we think that all our proposals are novel; what we are seeking to do is to give wider currency and to lend our support to practices which the leaders amongst the more imaginative and innovative bodies may already be thoroughly familiar with.
3. Our third general remark is this: these recommendations are directed to various quarters. We in no way imply that all of them can appropriately be put in hand by the ABRC; indeed most of them are directed elsewhere in Government, or to the universities, colleges or Research Councils.

A. GOVERNMENT

- i. Much fundamental research is to be seen as a public responsibility for which no significant substitution of private funds is possible. The civil science budget therefore needs to be maintained, and if possible enhanced, in real terms if the fundamental science base of the country is to be sustained. This is also a pre-condition for the successful implementation of the many possibilities for collaboration between public funding and private funding envisaged in this report, whether for the Research Councils or universities.
- ii. On the basis of a more detailed investigation (recommendation E.vi) Government should consider whether taxation concessions, in relation to covenanting restrictions, Capital Gains Tax, the present limits to tax concessions on gifts and other methods of donating money, would be an appropriate way of increasing the incentives for private funding of research (which would be at the expense of the tax base).
- iii. Government should establish an appropriate incentive structure for private funding by setting out guide-lines for enabling Research Councils to retain a substantial proportion of private earnings without penalty to their public funding (paragraphs 267–8). See also recommendation C.ii (assets arising from privatisation).
- iv. The assurance given by Government to universities that success in attracting private funds for research and increasing their direct earnings from the exploitation of research will not prejudice their UGC funding needs to be maintained.
- v. A comparable assurance is needed for the polytechnics.
- vi. If Research Councils are to be encouraged to pursue profit-making ventures certain Treasury rules governing the setting up of companies, participating in jointly-owned companies, accounting procedures, such as ‘annualisation’ of budgets and spending, retention and accumulation of earnings, need to be reviewed in order to accommodate such objectives (paragraph 267 et seq).
- vii. Equivalent clarification of an effective incentive structure and guide-lines for practice are required from local authorities in relation to the private earnings of polytechnics and other institutions of higher education (paragraph 103).
- viii. Government should further examine the ‘seed corn fund’ proposals advocated by the 1983 Muir Wood report with a view to increasing the incentives for private earnings from research (paragraphs 97, 103, 278).
- ix. We recommend that the audited figures for research and development expenditure should feature in the published annual accounts of companies (paragraph 171).

B. RECOMMENDATIONS RELATING TO RESEARCH COUNCILS

- i. In association with appropriate complementary action by Government (Recommendations Aiii–v) Research Councils should all take steps to see what advantage can properly be taken of the new freedom to exploit their research commercially given by the ending of the BTG monopoly (paragraphs 130, 153).
- ii. Clear rules and conditions need to be established for the reward of scientists within Research Councils for the exploitation of patents, licences and contracts arising from research programmes, under the new freedom.
- iii. Liaison will be required for this between the Research Councils and probably also between Research Councils and universities.
- iv. We recommend the establishment (where they have not already been set up) of special units within Research Councils to generate an awareness of the potential for commercial exploitation amongst Research Council scientific staff (paragraphs 50, 52–3). Education in the awareness of business requirements and expectations is a pre-condition for success in such ventures.
- v. Such units would also act as bridgeheads for contacts with industry, and for preparing publicity material. New structures can evolve quickly once the need is recognised.
- vi. We recommend, in conjunction with such plans, the preparation of registers of current research in Research Councils, which would be made available for interested firms. We see this as complementary to other ‘data bases’.
- vii. Research Councils should seek to develop further existing successful forms of collaboration with industry and universities/polytechnics (Alvey, CASE, Teaching Company Scheme, etc paragraph 64 et seq).
- viii. We encourage Research Councils to promote ‘tripartite’ joint funding of research in a ‘triple alliance’ with industry, particularly in an academic base, with participation in funding by the university/polytechnic (paragraph 180 et seq).
- ix. The opportunities for ‘tripartite’ or joint funding of research, centred on university premises, seem particularly rewarding for MRC and the medical charities (paragraphs 48–50, 243–57).
- x. To encourage such collaborative funding and to act as a forum for the discussion of research policies we recommend the establishment of a new body where MRC and the medical charities would be represented on equal terms (paragraph 255).
- xi. We recommend that the MRC, in common with the other Research Councils, should invite more representatives from industry to become members of the Council and its Board (paragraph 206).
- xii. We recommend that Research Councils should investigate, with outside representation, ways of increasing their flexibility and effectiveness in negotiating with industry (paragraphs 79, 234).
- xiii. In particular, we would like Research Councils to investigate the possibility of promoting corporate forms of organisation to provide appropriate vehicles for exploiting research, for developing their relationships with industrial firms, and for possible joint participation by venture capital interests (paragraph 79).
- xiv. Where Councils have internationally-marketable products, services and research facilities, they should consider the establishment of overseas agencies (as NERC has done). They should also explore the scope for liaison and co-operation in such overseas representation.
- xv. While bearing in mind their UK academic priorities, we encourage the Research Councils to extend the joint use of major facilities with private-sector customers, and also to pursue their current efforts to extend international co-operation as a means of offsetting the costs of their international subscriptions. (Paragraphs 57, 79, 182, 242).
- xvi. We are anxious that Research Councils and universities should capitalise on the opportunities for extending the range of joint funding of research with industry beyond short-term applied research into ‘strategic’ research wherever the field of science makes this possible (paragraph 79).

C. PRIVATISATION AND THE RESEARCH COUNCILS (paragraph 82 et seq.)

Where the privatisation of Research Council institutes is in question we recommend that:

- i. Successful privatisation should not prejudice the public funding of the Research Council concerned.
- ii. A Research Council should receive all, or a major share, of the assets sold, to allow the redeployment of its activities.

- iii. Following privatisation, a Research Council should be encouraged, where appropriate and advantageous, to maintain research links with the resulting non-public organisation conducting profitable applied research, development or production activities.
- iv. Research Councils should be encouraged to explore the possibilities of the joint-funding of institutes; or maintaining a stake in any independent organisation resulting from the privatisation or 'part-privatisation' of an institute.
- v. We make no recommendations about the possible privatisation of individual institutes: each case would deserve a detailed investigation.

D. RECOMMENDATIONS RELATING TO UNIVERSITIES AND POLYTECHNICS

Many of the recommendations featured in the section on Research Councils are relevant, either directly or by analogue, to universities and polytechnics.

- i. While each institution will decide for itself the appropriate modes and extent of the commitment it seeks in the private funding of research, we recommend that all universities and colleges should review the opportunities created by the ending of the BTG monopoly (paragraphs 130–131).
- ii. In particular we recommend that an investigation be made into possible corporate organisations for conducting relations with industry, negotiating contracts, patents and licences and acting more generally as vehicles for the joint participation by venture capital firms in these activities exploiting the results of university research (paragraph 227 et seq).
- iii. We have stressed in the previous section the need to make the necessary internal arrangements to allow universities and polytechnics to negotiate in clear-cut terms with outside firms. Apart from the need for effective managerial structures, such arrangements need to include prior arrangements over such matters as commercial confidentiality and the terms on which individual scientists and the universities/polytechnics will share in the rewards of such ventures. As with the Research Councils education in the awareness and expectations of the business community is an important pre-condition for success.
- iv. We recognise that particular attention needs to be paid to the problems of fostering research and consultancy links with smaller firms; and in such relationships the initiatives will usually have to be taken by the universities/polytechnics (paragraph 167).
- v. In the pricing of research contracts universities/polytechnics are recommended to identify appropriate overhead costs (keeping in mind the limitations of what the market will bear) (paragraphs 52, 108).
- vi. We recommend that university engineering departments investigate complaints that their specialised departmental structures with their particular approaches to research place constraints on collaboration with the mechanical engineering industries and explore the advantages of establishing integrated inter-departmental research teams for such ventures (paragraphs 221–222).
- vii. As with the Research Councils, we recommend that universities/polytechnics seek to extend the range of research contracts from short-term applied research to longer-term strategic research in the fields where opportunities offer, and explore the possibilities of joint-funding of research laboratories, participating in 'clubs' and in tripartite joint research ventures with Research Council and industry funding.
- viii. Amongst the many different modes of collaboration now being explored, we see interesting opportunities in establishing university/polytechnic 'consultancy clubs', from which other ventures may develop (paragraphs 195, 197).
- ix. We recommend that more systematic information should be exchanged between universities about their different activities in raising private income and funding research, perhaps using the CVCP as a clearing house. This exchange of information will itself demonstrate the range of possibilities and encourage emulation (paragraph 155).
- x. We recommend the creation of 'data-bases' and the compiling of registers of research, by individual universities and polytechnics, as well as their participation in more broadly-based data-bases, organised through the CVCP and possibly operated by the DTI (paragraph 156).

E. FOLLOW-UP INFORMATION AND ACTION

We are conscious of the need for better information in certain areas of data and recommend:

- i. Widening of the reporting base to provide more data on R and D funded by industry (paragraph 24).

- ii. An investigation to document more exactly the extent of research funded by the UGC grant in universities (paragraph 24).
- iii. An investigation into the extent of research conducted in polytechnics and other institutions of higher education (paragraph 95).
- iv. The provision of more quantified data by the Research Councils and universities on the joint funding of research, in order to identify the 'gearing' between public and private funding (paragraphs 30, 60–61).
- v. The identification of private income of universities and polytechnics in consultancies, endowment, gifts and income from wholly- and jointly-owned companies (paragraphs 95, 98, 195).
- vi. A more detailed investigation into the legal position relating to taxation and the private funding of research, with relevant international comparisons (paragraphs 258 et seq).
- vii. A more detailed investigation into the most appropriate organisational forms and associated arrangements for companies jointly sponsored by Research Councils, universities or polytechnics with venture capital interests.
- viii. A wider investigation and review of Science Parks (paragraph 140).
- ix. We encourage the Research Councils in their annual reports to give more details of their private earnings, jointly-funded projects and the different modes of collaboration with industry, so that the range of possibilities can be more widely recognised.

Research and development performed in each sector according to source of finance¹—1981

£ million

	Sector carrying out the work						Total performed in the United Kingdom	Research carried out abroad
	Government	Universities and further education establishments	Public corporations	Research associations	Private industry	Other		
Sector providing the funds								
Government	1,098.6	503.5	13.2	21.6	1,102.4	86.6	2,825.9	179.3
Universities ²	—	58.0	—	—	—	—	58.0	..
Public corporations	6.9	5.0	356.8	13.6	66.9	—	449.2	..
Research associations	—	—	—	17.7	—	—	17.7	..
Private industry	129.6	15.0	2.3	25.3	1,841.4	48.8	2,062.3	..
Overseas	63.2	13.0	12.6	9.9	308.8	3.9	411.4	..
Other	41.2	35.1	—	—	—	20.3	96.6	..
Total cost of research and development performed	1,339.4	629.6	384.8	88.1	3,319.5	159.6	5,921.1	..

¹ Research in the social sciences is excluded.² Including also further education establishments.

Source: Department of Trade and Industry (reproduced from Economic Trends, August 1984)

Changes in the distribution of R & D¹ performed or financed (1978 and 1981 compared)

	1978		1981	
	£ million	per cent	£ million	per cent
Work performed by government				
Defence	331.0	9.4	557.7	9.4
Civil				
Research Councils	152.3	4.3	250.2	4.2
Other civil research	271.8	7.7	526.5	8.9
Local government	3.0	0.1	5.0	0.1
Total government	758.1	21.6	1,339.4	22.6
Universities and further education establishments ²	317.3	9.0	629.6	10.6
Public corporations	212.5	6.1	384.8	6.5
Research associations	50.8	1.4	88.1	1.5
Private industry	2,061.0	58.7	3,319.5	56.1
Other	110.6	3.2	159.6	2.7
Total non-government	2,752.2	78.4	4,581.7	77.4
Total all sectors	3,510.3	100.0	5,921.1	100.0
Finance provided by				
Government				
Defence	949.8	25.4	1,666.7	24.8
Civil				
Research Councils	186.2	4.9	363.5	5.4
Other civil research	610.9	16.4	1,161.3	17.3
Local government	10.0	0.3	20.0	0.3
Total as returned by government	1,756.9	47.0	3,211.5	47.7
Total as returned by the sector carrying out the work				
Government	1,651.4	47.0	2,825.9	47.7
Universities and further education establishments	28.4	0.8	58.0	1.0
Public corporations	259.7	7.4	449.2	7.6
Private industry ³	1,292.4	36.8	2,080.1	35.1
Overseas	222.6	6.3	411.4	6.9
Other	55.8	1.6	96.6	1.6
Total non-government	1,858.9	53.0	3,095.3	52.3
Total all sectors	3,510.3	100.0	5,921.1	100.0

¹ Research in the social sciences is excluded.² Change in coverage between 1978 and 1981 tends to over emphasise the apparent increase.³ Private industry includes the research associations here.

Source: Department of Trade and Industry (reproduced from Economic Trends, August 1984)

Overall Distribution of Funding

Columns may not sum to totals shown owing to rounding

£ millions

Sector	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87
Intra-mural ¹	1,350.0	1,476.4	1,469.3	1,580.7	1,618.3	1,665.6
Research Councils ²	60.1	62.3	63.8	67.1	68.8	70.8
Other Government Departments ³	46.0	74.5	63.1	84.1	86.2	88.8
Universities	639.6	697.8	2,767.3	3,038.2	3,159.9	3,244.8
Private industry	1,395.3	1,239.9				
Public Corporations	54.2	48.3				
Research Associations	14.5	23.1				
Overseas	185.0	212.4				
Non-industrial research institutes ⁴	89.4	94.2	429.1	435.7	446.7	466.0
Professional and learned societies	4.4	4.6				
Persons	40.2	42.7				
Others	27.3	31.9				
less Receipts ⁵	400.0	383.4				
Total	3,507.0	3,624.8	3,934.5	4,324.4	4,486.4	4,604.0

¹ Expenditures within Departments' and Research Councils' own establishments and headquarters units carried on their own budget.

² Departmental commissions with Research Councils.

³ Departmental commissions with other Departments' establishments (which are offset against those Departments' votes and are included in *the* receipts line).

⁴ Independent research institutes receiving funds mainly from AFRC, Department of Agriculture and Fisheries for Scotland, NERC and MRC.

⁵ From other Government Departments, private industry, international subscriptions etc.

Source: Annual Review of Government Funded R & D 1984 (HMSO)

Current and capital expenditure on research and development¹—1981

£ million

	Current				Capital			Total current and capital
	Salaries and wages	Materials and equipment	Other expenditure	Total	Land and buildings	Plant and equipment	Total	
Sector carrying out the work								
Government:								
Defence	343.0	144.7	17.6	505.3	15.1	37.3	52.4	557.7
Civil								
Research Councils	123.5	50.0	32.6	206.1	15.6	28.5	44.0	250.2
Other central government	255.2	93.6	136.5	485.3	11.9	29.3	41.2	526.5
Local authorities ²	2.9	1.5	0.3	4.7	0.1	0.2	0.3	5.0
Total government	724.5	289.9	187.1	1,201.5	42.7	95.2	137.9	1,339.4
Universities and further education establishments	339.5	32.9	220.2	592.6	2.1	35.0	37.0	629.6
Public corporations	179.4	121.5	67.0	367.9	3.7	13.3	16.9	384.8
Research associations	47.3	10.5	22.7	80.4	2.8	4.9	7.7	88.1
Private industry	1,476.1	764.5	780.4	3,020.9	93.5	205.1	298.6	3,319.5
Non-profit-making organisations	34.9	5.6	6.1	46.6	2.9	2.0	4.9	51.5
Total (excluding other organisations)	2,801.6	1,224.8	1,283.4	5,309.9	147.6	355.5	503.1	5,813.0
Other organisations	..	..	..	..	..	..	..	108.1
Total	..	..	..	..	..	..	..	5,921.1

¹ Research in the social sciences is excluded.² Estimated.

Source: Department of Trade and Industry (reproduced from Economic Trends, August 1984)

Current expenditure on research and development by type of work¹—1981

£ million

	Basic research	Applied research	Development	Unallocated	Total
Sector carrying out the work					
Government:					
Defence	—	176.1	329.3	—	505.3
Civil					
Research Councils	163.9	42.3	—	—	206.1
Other central government	32.6	188.0	250.2	14.5	485.3
Local authorities ²	—	2.2	2.5	—	4.7
Total civil	196.5	232.5	252.7	14.5	696.1
Total government	196.5	408.6	581.9	14.5	1,201.5
Non-government:					
Universities and further education establishments	—	—	—	592.6	592.6
Public corporations	5.6	130.4	231.9	—	367.9
Research associations	6.0	48.2	26.2	—	80.4
Private industry	77.0	514.3	2,429.6	—	3,020.9
Non-profit-making organisations	12.0	27.2	7.4	—	46.6
Total non-government ³	100.7	720.2	2,695.1	592.6	4,108.4
Total ³	297.1	1,128.7	3,277.0	607.1	5,309.9

¹ Research in the social sciences is excluded.² Estimated.³ Excluding other organisations.

Source: Department of Trade and Industry (reproduced from Economic Trends, August 1984)

Primary purposes for government-funded R & D, in cash terms

Columns may not sum to totals shown owing to rounding

£ millions

Primary Purpose	Outturn			Estimated Outturn 1984/85	Plans		
	1981/82	1982/83	1983/84		1985/86	1986/87	1987/88
Advancement of science	573.0	622.2	724.2	753.5	777.2	792.4	813.6
Support for policy	483.3	511.0	451.0	461.4	478.1	476.9	480.2
Improvement of technology	549.2	568.9	617.1	694.1	726.4	734.3	636.8
Support for purchasing decisions	1,783.1	1,802.0	2,018.2	2,210.4	2,418.9	2,512.3	2,592.5
Support for statutory duties	61.1	63.6	70.5	77.7	81.6	85.9	84.9
Support for other activities	56.6	58.7	42.1	42.9	47.9	50.2	51.6
Total	3,506.3	3,626.4	3,923.1	4,240.0	4,530.1	4,652.0	4,659.6

Primary purposes for government-funded R & D, percentages

Columns may not sum to totals shown owing to rounding

Primary Purpose	Outturn			Estimated Outturn 1984/85	Plans		
	1981/82	1982/83	1983/84		1985/86	1986/87	1987/88
Advancement of science	16.3	17.2	18.5	17.8	17.2	17.0	17.5
Support for policy	13.8	14.1	11.5	10.9	10.6	10.3	10.3
Improvement of technology	15.7	15.7	15.7	16.4	16.0	15.8	13.7
Support for procurement decisions	50.9	49.7	51.4	52.1	51.4	54.0	55.6
Support for statutory duties	1.7	1.8	1.8	1.8	1.8	1.8	1.8
Support for other activities	1.6	1.6	1.1	1.0	1.1	1.1	1.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Primary purposes for government-funded R & D, in cost terms

Index, 1983/84 = 100

Primary Purpose	Outturn			Estimated Outturn 1984/85	Plans		
	1981/82	1982/83	1983/84		1985/86	1986/87	1987/88
Advancement of science	88	90	100	99	98	96	96
Support for policy	119	118	100	98	97	93	91
Improvement of technology	99	96	100	107	108	105	88
Support for procurement decisions	98	93	100	105	109	109	109
Support for statutory duties	97	94	100	105	106	107	102
Support for other activities	150	146	100	97	104	105	104
All purposes	100	97	100	103	105	104	101

Source: Annual Review of Government Funded R & D 1985 (HMSO)

GDP and R & D expenditure by manufacturing industry

Industry Sector	Contribution to GDP 1981 (£m)	Intra-mural R&D Expenditure 1981 (£m)	R&D % of GDP 1981	% Increase in R&D Expenditure 1975–1983 (constant prices)	Compound Annual Growth Rate 1975–1981 % (current prices)	
					Intra-mural R&D	GDP
All Manufacturing	53,883	2,749*	5.1	13.3	18%	12%
Mechanical Engineering	10,609	234	2.2	–4.2	17%	11%
Food, Drink & Tobacco	7,581	92	1.2	N/A	N/A	15%
Electrical & Electronic Engineering	6,859	1,417	20.7	63.1	24%	14%
Motor Vehicle	6,225	180	2.9	3.1	13%	12%
Chemicals	4,845	617	12.7	9.8	17%	13%
Textiles, Footwear & Clothing	3,602	15	0.4	N/A	N/A	7.2%

* excluding aerospace

Source: DTI material published in British Business

Analysis of total expenditure on R & D 1972 to 1983: private industry, public corporations and industrial research associations (£m)

	1972	1975	1978	1981	1983
Total R & D Expenditure	838.5	1,352.3	2,341.0	N/A	N/A
Carried out within industry: total	830.5	1,340.1	2,324.3	3,792.5	4,163.3
Private industry	742.5	1,185.1	2,061.0	3,319.5	3,637.1
Public corporations	69.2	124.0	212.5	348.8	526.2
Research Associations	18.8	31.1	50.8	88.1	
Put out by industry to other sectors	8.0	12.2	16.7	N/A	N/A
Funds for industry's R & D					
Total	838.5	1,352.3	2,341.0	3,792.5	4,163.3
Government funds	277.3	414.1	629.7	1,137.2	1,257.6
Overseas funds	54.0	84.9	185.6	331.3	283.2
Other funds (mainly own funds)	507.2	853.3	1,478.7	2,324.0	2,622.5
% of total	100	100	100	100	100
Government funds	33	31	29	30	30
Overseas funds	6	6	8	9	7
Other funds (mainly own funds)	60	63	63	61	63

Source: DTI material published in British Business

Changes in intra-mural industrial R & D expenditure: 1975–1983

Total expenditure £m (rounded)

	At current prices				At 1975 prices		
	1975	1978	1981	1983	1978	1981	1983
All product groups	1,340	2,324	3,792	4,163	1,566	1,661	1,564
All manufacturing	1,293	2,243	3,549	3,901	1,512	1,555	1,465
Chemicals etc	254	425	655	766	284	277	279
Mech Eng	103	181	276	260	118	111	99
Electronics	279	650	1,153	1,391	442	511	529
Other Elect Eng	73	101	121	118	69	53	45
Motor vehicles	88	130	180	239	88	80	91
Aerospace	291	425	763	720	285	337	272
Other manufactures	213	333	401	407	226	185	151

Source: DTI material published in British Business

Intra-mural expenditure by industry on R & D in 1983, related to industry turnover

Manufacturing Industry	Turnover (£m)	R & D expenditure (£m)	R & D % of turnover
Minerals and mineral products	10,564	35.6	0.3
Chemicals industry: Total	22,265	735.0	3.3
pharmaceuticals	3,597	377.7	10.5
other chemicals	18,668	357.3	1.9
Metal goods	15,590	22.5	0.1
Mechanical engineering: Total	24,215	249.6	1.0
industrial plant and steelwork	4,121	18.0	0.4
metal-working machine tools	5,538	13.2	0.2
construction and earthmoving	1,108	34.4	0.3
other machinery and equipment	13,448	184.0	1.4
Office machinery	224	10.7	4.8
Data processing equipment	2,064	247.3	12.0
Electrical and electronic engineering: Total	17,682	1,333.6	7.5
insulated wires and cables	1,263	11.5	0.9
basic electrical equipment	3,060	58.8	1.9
telegraph and telephone apparatus	1,480	360.3	24.3
electrical instruments and control systems	1,115	72.3	6.5
radio and electronic capital goods	2,800	633.3	22.6
components other than active	1,226	49.7	4.1
active components and sub-assemblies	1,511	77.6	5.1
electronic consumer goods	1,091	22.7	2.1
other electrical	4,136	47.4	1.1
Motor vehicles and parts	13,220	239.5	1.8
Shipbuilding and repairs	2,350	8.4	0.4
Aerospace equipment man and rep	5,226	720.0	13.8
Instrument engineering	2,862	49.4	1.7
Food, drink and tobacco	26,618	80.2	0.3
Textiles	5,877	10.2	0.2
Leather, footwear and clothing	6,622	5.3	0.1
Timber and wooden furniture	11,337	3.9	—
Paper and paper products	19,755	21.4	0.1
Rubber and plastics processing	7,321	24.7	0.3

Source: British Business; Business Monitor (Department of Trade and Industry)

Research Councils: distribution of funding (1983–84)

	£m				%			
	Intra-mural	Universities	Rest	Total	Intra-mural	Universities	Rest	Total
AFRC	44.0	4.8	52.1	100.9	43.6	4.8	51.6	100.0
ESRC	3.3	9.6	4.9	17.8	18.6	53.9	27.5	100.0
MRC	73.8	33.6	11.7	119.1	62.0	28.2	9.8	100.0
NERC	69.2	7.1	10.1	86.4	80.1	8.2	11.7	100.0
SERC	92.1	78.8	84.3	255.2	36.1	30.9	33.0	100.0

Notes: Gross spend, ignoring receipts. 'Rest' includes category 'Persons'. Universities receive benefit from spending under other categories eg use of facilities run by SERC.

Source: Annual Review of Government Funded R & D 1985 (HMSO)

Research Councils: receipts

Columns may not sum to totals owing to rounding

£ millions

	1983/84	1984/85	1985/86	1986/87	1987/88
AFRC	55.6	56.7	57.1	59.4	60.8
ESRC	0.3	0.4	0.4	0.4	0.4
MRC	6.1	6.6	6.8	7.1	7.3
NERC	26.7	27.1	26.3	26.7	27.8
SERC	10.0	11.4	14.1	15.0	15.0
Total	98.7	102.2	104.7	108.6	111.3

Source: Annual Review of Government Funded R & D 1985 (HMSO)**Distribution of departmental R & D expenditures*—percentages**

Columns may not sum to totals owing to rounding

Sector	1982/83	1983/84	1984/85	1985/86	1986/87
Intra-mural	37.6	31.8	31.8	31.2	31.2
Research Councils	2.3	2.2	2.1	2.0	2.0
Universities	1.6	66.0	66.1	66.8	66.8
Private Industry	46.9				
Public Corporations	1.8				
Research Associations	0.9				
Overseas	6.3				
Non-industrial research Institutes	1.2				
Professional and learned societies	0.2				
Persons	0.2	66.0	66.1	66.8	66.8
Others	1.1				
Total	100.0	100.0	100.0	100.0	100.0

* Excluding Research Councils and UGC etc.

Source: Annual Review of Government Funded R & D 1984 (HMSO)

Forecast of receipts from non-science budget sources

Sources of receipts £m	1985-86	1986-87	1987-88	1988-89
AFRC				
Commissioned by Gvt Depts				
MAFF	51.8	47.9	43.5	44.6
Other	2.2	2.3	2.4	2.4
Commissioned by industry	2.5	4.8	6.0	7.0
Other commissions—EC	0.4	0.4	0.5	0.5
Public sector—Fees for Services	0.2	0.2	0.2	0.2
Private sector				
Sale of Produce	3.0	3.2	3.3	3.5
Rents	0.7	0.7	0.8	0.8
Miscellaneous	0.7	0.7	0.8	0.9
Total	61.5	60.2	57.5	59.9
ESRC				
Commissioned by Gvt Depts	0.2	0.3	0.3	0.2
Commissioned by industry	—	0.1	0.3	0.5
Other	0.2	0.2	0.2	0.2
Total	0.4	0.6	0.8	0.9
MRC				
Commissioned by Gvt Depts				
ODA	1.6	1.6	1.7	1.7
HSE	0.6	0.6	0.6	0.7
DHSS	0.2	0.2	0.2	0.2
Other	0.1	0.1	0.1	0.1
Commissioned by industry	0.7	0.7	0.7	0.8
Other commissions				
WHO	0.3	0.3	0.3	0.3
EEC	0.3	0.3	0.3	0.3
Charities	0.5	0.5	0.5	0.5
Other public bodies	0.4	0.4	0.4	0.4
Overseas bodies	0.5	0.5	0.6	0.6
Public sector	0.9	0.9	0.9	1.0
Private sector	0.2	0.2	0.2	0.2
Total	6.3	6.3	6.5	6.8
NERC				
Commissioned by Gvt Depts				
DOI	2.3	2.2	2.2	2.3
D.En	7.9	8.3	8.6	8.8
DOE	4.5	4.4	4.5	4.7
MAFF	2.2	2.3	2.3	2.4
ODA	2.8	2.9	3.0	3.0
Other	0.4	0.4	0.4	0.4
Commissioned by industry	0.7	0.8	1.0	1.2
Other commissions				
Nature Conservancy Council	0.2	0.3	0.3	0.3
CEC	1.0	0.8	1.0	1.1
Others	2.9	3.0	3.1	3.1
Public sector	1.4	1.3	1.4	1.4
Private sector	1.5	1.3	1.4	1.4
Total	27.8	28.0	29.2	30.1

Sources of receipts £m	1985–86	1986–87	1987–88	1988–89
SERC				
Public sector				
SNS	0.4	0.1		
CERN Contract	1.6	0.6	0.2	
NASA/ESA Contract	0.9	0.6	0.5	0.5
NASA/ESA/Met Office	—	—	0.1	0.1
NATO Fellowship Scheme	0.7	0.7	0.7	0.7
JNT Network Executive	0.3	0.3	0.3	0.3
Miscellaneous	2.8	2.2	2.1	2.2
Private sector	1.9	1.6	1.6	1.6
Total	8.6	6.1	5.5	5.3
TOTAL				
Commissioned by Gvt Depts	76.8	73.5	69.8	71.5
Commissioned by industry	3.9	6.4	8.0	9.5
Other commissions	6.5	6.5	7.0	7.1
Other	17.4	14.8	14.7	14.9
GRAND TOTAL	104.6	101.2	99.5	103.0

Source: Advisory Board for the Research Councils

Recurrent income received by each university analysed by source, 1983–84

		Total recurrent income	Exchequer grants	Fees						
		£ thousands		Full-time courses				Part-time courses		
				Home rates		Other rates				
				%	%		%		%	
1	Aston	25,531	17,088	66.9	2,140	8.4	1,592	6.2	238	0.9
2	Bath	19,982	12,812	64.1	1,978	9.9	1,045	5.2	136	0.7
3	Birmingham	59,988	37,655	62.8	4,631	7.7	1,834	3.1	365	0.6
4	Bradford	25,553	17,086	66.9	2,196	8.6	1,472	5.8	165	0.6
5	Bristol	48,758	30,477	62.5	3,675	7.5	798	1.6	115	0.2
6	Brunel	20,178	13,474	66.8	1,392	6.9	727	3.6	110	0.5
7	Cambridge	73,103	40,831	55.9	6,200	8.5	3,637	5.0	246	0.3
8	City	21,090	12,630	59.9	1,386	6.6	1,640	7.8	241	1.1
9	Durham	25,385	17,525	69.0	2,491	9.8	491	1.9	119	0.5
10	East Anglia	21,422	15,194	70.9	2,084	9.7	1,212	5.7	127	0.6
11	Essex	15,523	8,888	57.3	1,558	10.0	2,154	13.9	66	0.4
12	Exeter	22,514	15,549	69.1	2,464	10.9	612	2.7	150	0.7
13	Hull	21,717	15,222	70.1	2,505	11.5	788	3.6	90	0.4
14	Keele	13,544	8,860	65.4	1,369	10.1	667	4.9	62	0.5
15	Kent	19,189	11,397	59.4	1,921	10.0	2,093	10.9	87	0.5
16	Lancaster	21,031	13,860	65.9	2,328	11.1	1,140	5.4	288	1.4
17	Leeds	63,917	42,469	66.4	5,336	8.3	2,858	4.5	178	0.3
18	Leicester	27,406	17,809	65.0	2,584	9.4	508	1.9	284	1.0
19	Liverpool	53,177	37,996	71.5	3,991	7.5	2,150	4.0	274	0.5
20	London Business School	4,965	2,057	41.4	352	7.1	213	4.3	—	—
21	London University	413,864	235,896	57.0	21,132	5.1	20,852	5.0	3,647	0.9
22	Loughborough	29,573	17,779	60.1	2,621	8.9	1,678	5.7	138	0.5
23	Manchester Business School	3,919	1,141	29.1	242	6.2	108	2.7	57	1.4
24	Manchester University	74,685	47,707	63.9	5,815	7.8	2,598	3.5	223	0.3
25	Manchester Institute of Science and Technology	31,288	17,097	54.6	2,254	7.2	3,017	9.6	26	0.1
26	Newcastle	48,754	31,376	64.4	3,747	7.7	2,392	4.9	141	0.3
27	Nottingham	45,202	28,070	62.1	3,659	8.1	1,160	2.6	200	0.4
28	Oxford	80,969	42,397	52.4	6,565	8.1	3,341	4.1	51	0.1
29	Reading	31,117	19,111	61.4	2,888	9.3	2,027	6.5	143	0.5
30	Salford	24,621	16,434	66.7	1,652	6.7	1,725	7.0	139	0.6
31	Sheffield	47,109	32,818	69.7	4,112	8.7	1,554	3.3	103	0.2
32	Southampton	44,095	24,447	55.4	3,466	7.9	1,290	2.9	172	0.4
33	Surrey	23,501	14,004	59.6	1,563	6.7	1,336	5.7	235	1.0
34	Sussex	24,427	14,061	57.6	2,266	9.3	1,533	6.3	114	0.5
35	Warwick	28,533	17,611	61.7	2,794	9.8	1,032	3.6	187	0.7
36	York	17,731	11,374	64.1	1,905	10.7	616	3.5	41	0.2
37	Total England	1,573,364	960,200	61.0	119,262	7.6	73,891	4.7	8,959	0.6
38	Aberystwyth University College	18,514	10,804	58.4	1,533	8.3	527	2.8	17	0.1
39	Bangor University College	16,073	10,976	68.3	1,341	8.3	499	3.1	85	0.5
40	Cardiff University College	26,864	17,724	66.0	2,449	9.1	2,360	8.8	197	0.7
41	St. David's Lampeter	2,960	2,348	79.4	368	12.4	16	0.5	4	0.1
42	Swansea University College	19,592	13,348	68.1	1,837	9.4	976	5.0	20	0.1
43	University of Wales Institute of Science and Technology	14,460	9,205	63.7	1,250	8.6	1,719	11.9	27	0.2
44	Welsh National School of Medicine	13,799	6,430	46.6	386	2.8	274	2.0	72	0.5
45	University of Wales Central Registry	2,942	1,987	67.5	—	—	—	—	—	—
46	Total Wales	115,204	72,823	63.2	9,163	8.0	6,371	5.5	422	0.4
47	Total England and Wales	1,688,567	1,033,023	61.2	128,426	7.6	80,261	4.8	9,381	0.6
48	Aberdeen	37,005	24,170	65.3	2,952	8.0	767	2.1	80	0.2
49	Dundee	24,016	17,157	71.4	1,746	7.3	760	3.2	8	—
50	Edinburgh	73,523	45,432	61.8	5,236	7.1	1,931	2.6	227	0.3
51	Glasgow	68,802	46,900	68.2	5,085	7.4	2,775	4.0	370	0.5
52	Heriot-Watt	20,040	11,712	58.4	1,334	6.7	1,468	7.3	160	0.8
53	St Andrews	17,164	12,185	71.0	1,670	9.7	814	4.7	22	0.1
54	Stirling	13,398	9,044	67.5	1,304	9.7	436	3.3	70	0.5
55	Strathclyde	40,267	25,627	63.6	3,932	9.8	3,188	7.9	123	0.3
56	Total Scotland	294,215	192,228	65.3	23,259	7.9	12,139	4.1	1,060	0.4
57	Total Great Britain	1,982,782	1,225,251	61.8	151,685	7.7	92,400	4.7	10,440	0.5
58	Queen's University, Belfast	40,943	30,310	74.0	3,554	8.7	422	1.0	355	0.9
59	University of Ulster, Coleraine	11,043	8,922	80.8	1,147	10.4	179	1.6	102	0.3
60	Total Northern Ireland	51,986	39,231	75.5	4,701	9.0	601	1.2	457	0.9
61	Total United Kingdom	2,034,768	1,264,482	62.1	156,386	7.7	93,001	4.6	10,897	0.5

Research training and other support grants		Endowments, donations and subscriptions		Computer board grants		Other general recurrent income		Research grants and contracts		Income for other services rendered	
	%		%		%		%		%		%
85	0.3	36	0.1	109	0.4	1,160	4.5	2,629	10.3	454	1.8
134	0.7	—	—	72	0.4	588	2.9	2,459	12.3	757	3.8
115	0.2	1,142	1.9	273	0.5	2,442	4.1	8,153	13.6	3,379	5.6
27	0.1	3	—	138	0.5	1,500	5.9	1,923	7.5	1,043	4.1
194	0.4	186	0.4	196	0.4	2,641	5.4	8,652	17.7	1,824	3.7
16	0.1	—	—	117	0.6	995	4.9	2,770	13.7	578	2.9
284	0.4	1,817	2.5	390	0.5	4,171	5.7	14,786	20.2	740	1.0
36	0.2	340	1.6	151	0.7	1,927	9.1	1,849	8.8	888	4.2
53	0.2	206	0.8	149	0.6	1,031	4.1	2,724	10.7	595	2.3
44	0.2	43	0.2	140	0.7	495	2.3	1,923	9.0	161	0.7
17	0.1	—	—	194	1.3	570	3.7	1,572	10.1	503	3.2
60	0.3	162	0.7	99	0.4	1,142	5.1	1,478	6.6	798	3.5
21	0.1	359	1.7	147	0.7	964	4.4	1,580	7.3	42	0.2
11	0.1	50	0.4	126	0.9	1,106	8.2	1,237	9.1	56	0.4
26	0.1	19	0.1	150	0.8	1,234	6.4	2,122	11.1	140	0.7
39	0.2	160	0.8	195	0.9	701	3.3	1,480	7.0	839	4.0
115	0.2	158	0.2	304	0.5	1,932	3.0	8,015	12.5	2,551	4.0
77	0.3	67	0.2	140	0.5	1,255	4.6	3,725	13.6	957	3.5
129	0.2	241	0.5	228	0.4	1,272	2.4	5,286	9.9	1,609	3.0
—	—	—	—	—	—	186	3.7	961	19.4	1,196	24.1
1,928	0.5	6,436	1.6	5,040	1.2	9,313	2.3	84,858	20.5	24,763	6.0
33	0.1	5	—	175	0.6	855	2.9	4,825	16.3	1,464	4.9
—	—	27	0.7	20	0.5	162	4.1	179	4.6	1,983	50.6
142	0.2	387	0.5	2,671	3.6	3,331	4.5	9,679	13.0	2,131	2.9
50	0.2	29	0.1	—	—	1,253	4.0	5,673	18.1	1,889	6.0
93	0.2	439	0.9	207	0.4	2,430	5.0	7,357	15.1	572	1.2
111	0.2	723	1.6	373	0.8	3,525	7.8	6,445	14.3	935	2.1
307	0.4	4,439	5.5	464	0.6	2,312	2.9	19,251	23.8	1,844	2.3
94	0.3	42	0.1	160	0.5	1,596	5.1	3,850	12.4	1,207	3.9
38	0.2	45	0.2	264	1.1	542	2.2	1,896	7.7	1,886	7.7
83	0.2	669	1.4	240	0.5	781	1.7	6,154	13.1	595	1.3
156	0.4	792	1.8	314	0.7	1,338	3.0	7,925	18.0	4,196	9.5
29	0.1	76	0.3	111	0.5	1,061	4.5	3,729	15.9	1,356	5.8
74	0.3	13	0.1	90	0.4	1,219	5.0	4,802	19.7	256	1.0
66	0.2	134	0.5	191	0.7	1,042	3.7	4,125	14.5	1,351	4.7
30	0.2	36	0.2	81	0.5	409	2.3	2,939	16.6	299	1.7
4,719	0.3	19,284	1.2	13,721	0.9	58,480	3.7	249,010	15.8	65,837	4.2
29	0.2	85	0.5	74	0.4	456	2.5	4,711	25.4	279	1.5
54	0.3	12	0.1	154	1.0	1,077	6.7	1,875	11.7	—	—
46	0.2	54	0.2	168	0.6	751	2.8	2,542	9.5	573	2.1
—	—	13	0.4	23	0.8	83	2.8	71	2.4	34	1.2
49	0.3	43	0.2	98	0.5	566	2.9	2,049	10.5	607	3.1
19	0.1	—	—	106	0.7	236	1.6	1,266	8.8	631	4.4
1	—	131	0.9	8	0.1	444	3.2	4,409	32.0	1,644	11.9
275	9.3	21	0.7	—	—	335	11.4	—	—	324	11.0
472	0.4	359	0.3	631	0.5	3,948	3.4	16,923	14.7	4,092	3.6
5,191	0.3	19,642	1.2	14,352	0.8	62,428	3.7	265,932	15.7	69,930	4.1
117	0.3	503	1.4	253	0.7	1,316	3.6	3,850	10.4	2,998	8.1
—	—	164	0.7	94	0.4	647	2.7	2,963	12.3	475	2.0
191	0.3	883	1.2	710	1.0	2,764	3.8	10,794	14.7	5,355	7.3
211	0.3	1,395	2.0	243	0.4	2,410	3.5	7,871	11.4	1,543	2.2
60	0.3	39	0.2	109	0.5	620	3.1	2,409	12.0	2,130	10.6
49	0.3	119	0.7	107	0.6	895	5.2	1,284	7.5	20	0.1
159	1.2	70	0.5	52	0.4	846	6.3	978	7.3	439	3.3
72	0.2	40	0.1	220	0.5	572	1.4	5,734	14.2	759	1.9
859	0.3	3,213	1.1	1,787	0.6	10,070	3.4	35,883	12.2	13,718	4.7
6,050	0.3	22,855	1.2	16,140	0.8	72,498	3.7	301,815	15.2	83,648	4.2
66	0.2	54	0.1	—	—	316	0.8	3,670	9.0	2,196	5.4
12	0.1	—	—	66	0.6	209	1.9	395	3.6	12	0.1
77	0.1	54	0.1	66	0.1	525	1.0	4,065	7.8	2,208	4.2
6,128	0.3	22,909	1.1	16,206	0.8	73,024	3.6	305,880	15.0	85,856	4.2

Recurrent income received by each university from research grants and contracts and for other services rendered, 1983-84

£ thousands

	Research grants and contracts					Other services rendered				
	Total	Research councils	Government	Industry	Other sources	Total	Special and short courses	From government departments	From hospital authorities	Other
Aston	2,629	950	639	452	588	454	304	—	26	124
Bath	2,459	961	799	304	394	757	247	77	—	432
Birmingham	8,153	4,191	1,525	668	1,769	3,379	2,681	—	575	123
Bradford	1,923	692	510	305	417	1,043	1,041	—	—	2
Bristol	8,652	4,412	1,728	626	1,885	1,824	330	219	726	549
Brunel	2,770	697	964	277	830	578	335	—	—	243
Cambridge	14,786	8,550	1,441	1,637	3,158	740	210	264	12	254
City	1,849	441	306	411	690	888	866	—	—	23
Durham	2,724	1,296	638	426	364	595	595	—	—	—
East Anglia	1,923	808	422	148	545	161	151	—	—	9
Essex	1,572	941	179	193	259	503	165	—	—	338
Exeter	1,478	525	621	62	270	798	291	216	—	291
Hull	1,580	895	347	220	118	42	23	—	—	19
Keele	1,237	463	618	17	139	56	21	—	—	35
Kent	2,122	940	822	95	265	140	—	—	—	140
Lancaster	1,480	1,084	145	32	219	839	297	—	—	542
Leeds	8,015	3,180	1,465	1,131	2,239	2,551	393	87	1,693	378
Leicester	3,725	2,077	529	634	485	957	54	72	699	132
Liverpool	5,286	2,799	717	478	1,293	1,609	50	—	1,089	470
London Business School	961	148	43	506	263	1,196	1,196	—	—	—
London University	84,858	31,894	11,470	8,269	33,226	24,763	1,951	780	19,389	2,643
Loughborough	4,825	1,507	1,668	880	769	1,464	1,108	—	—	356
Manchester Business School	179	—	21	—	159	1,983	1,983	—	—	—
Manchester University	9,679	4,743	2,433	619	1,885	2,131	80	736	606	710
Manchester Institute of Science and Technology	5,673	2,840	887	1,252	693	1,889	270	—	—	1,619
Newcastle	7,357	3,095	1,123	1,068	2,072	572	318	132	23	99
Nottingham	6,445	2,771	913	1,558	1,203	935	157	203	44	531
Oxford	19,251	10,507	2,957	1,496	4,291	1,844	196	129	186	1,333
Reading	3,850	1,341	1,286	349	873	1,207	969	226	—	12
Salford	1,896	905	325	244	423	1,886	568	26	10	1,283
Sheffield	6,154	3,125	1,151	588	1,291	595	117	—	145	333
Southampton	7,925	3,268	2,744	504	1,409	4,196	544	250	212	3,190
Surrey	3,729	1,235	1,217	682	595	1,356	543	35	170	609
Sussex	4,802	2,798	504	482	1,018	256	202	—	—	54
Warwick	4,125	2,694	721	133	577	1,351	559	—	—	792
York	2,939	890	1,091	61	897	299	85	—	—	214
Total England	249,010	109,662	44,971	26,807	67,569	65,837	18,900	3,452	25,605	17,882

£ thousands

	Research grants and contracts					Other services rendered				
	Total	Research councils	Government	Industry	Other sources	Total	Special and short courses	From government departments	From hospital authorities	Other
Aberystwyth University										
College	4,711	3,900	564	191	55	279	—	—	—	279
Bangor University College	1,875	719	695	243	218	—	—	—	—	—
Cardiff University College	2,542	1,111	694	552	185	573	294	119	—	161
St. David's, Lampeter	71	12	30	1	28	34	34	—	—	—
Swansea University College	2,049	915	398	316	420	607	607	—	—	—
University of Wales Institute of Science and Technology	1,266	379	434	357	96	631	344	—	—	287
Welsh National School of Medicine	4,409	492	634	303	2,981	1,644	74	8	1,444	118
University of Wales Central Registry	—	—	—	—	—	324	11	8	—	305
Total Wales	16,923	7,528	3,449	1,963	3,982	4,092	1,364	135	1,444	1,149
Total England and Wales	265,932	117,190	48,420	28,770	71,552	69,930	20,263	3,587	27,049	19,031
Aberdeen	3,850	1,450	1,413	351	636	2,998	41	193	2,645	120
Dundee	2,963	1,324	954	286	399	475	—	—	334	141
Edinburgh	10,794	5,428	2,090	1,017	2,258	5,355	118	311	1,501	3,425
Glasgow	7,871	3,918	1,327	677	1,950	1,543	145	—	516	882
Heriot-Watt	2,409	1,642	468	134	165	2,130	99	—	—	2,031
St. Andrews	1,284	782	124	50	327	20	—	—	—	20
Stirling	978	327	454	84	113	439	249	—	—	190
Strathclyde	5,734	1,666	2,121	995	953	759	555	11	12	181
Total Scotland	35,883	16,537	8,952	3,593	6,801	13,718	1,206	514	5,008	6,989
Total Great Britain	301,815	133,727	57,372	32,363	78,353	83,648	21,469	4,101	32,057	26,020
Queen's University, Belfast	3,670	1,636	827	270	938	2,196	—	1,238	—	958
University of Ulster, Coleraine	395	116	130	31	117	12	10	—	—	2
Total Northern Ireland	4,065	1,752	957	301	1,056	2,208	10	1,238	—	960
Total United Kingdom	305,880	135,479	58,329	32,664	79,409	85,856	21,479	5,339	32,057	26,980

These figures do not include receipts from companies wholly or partly owned by the universities concerned, similarly excluded is consultancy income received by individual academics.

Source: University Statistics 1983–84. Vol. 3 Finance (UGC/USR 1985)

Organisations which submitted oral or written evidence to the working party or which were consulted in the course of the study

- *Agricultural and Food Research Council
- *Association of Medical Research Charities
Association of Scientific Technical and Managerial Staff
- *British Telecom
Cancer Research Campaign
Charities Aid Foundation
- *Committee of Vice-Chancellors and Principals
The Charity Commission
Committee of Directors of Polytechnics
- *Confederation of British Industry
- *Department of Education and Science
- *Department of Trade and Industry
- *Economic and Social Research Council
- *Equity Capital for Industry
Ernst and Whinney
- *General Electric Company
- *Imperial Chemical Industries
- *Investors in Industry
Professor Sir Hans Kornberg FRS
Loughborough University
- *Lucas Industries
- *Medical Research Council
- *Midland Bank Venture Capital
National Advisory Body for Public Sector Higher Education
- *Natural Environment Research Council
- *Nuffield Foundation
- *Prutec†
Queen Mary College, University of London
- *Science and Engineering Research Council
HM Treasury
- *Unilever
University Grants Committee
- *Wellcome Trust
- *Wolfson Foundation

* The Working Party had meetings with representatives of these bodies.

† This organisation has now ceased to exist as a separate company.

Companies interviewed by Miss Jones**INDUSTRIAL COMPANIES INTERVIEWED**

Allied Colloids
Amersham International
Beecham Group
BICC
Blue Circle Industries
BOC Group
British Aerospace
British Gas Corporation
Cable and Wireless
Celltech
Courtaulds
De La Rue Company
Ferranti
Glaxo Holdings
Grand Metropolitan
Guest Keen and Nettlefold
Arthur Guinness and Sons
Hawker Siddeley Group (letter only)
IMI
Jaguar Cars
Metal Box
Morgan Crucible
Pilkington Brothers
Plessey Corporation
Rowntree Mackintosh
John Sainsbury
Shell Transport and Trading
Smiths Industries
Standard Telephones and Cables
Tate and Lyle
Vantona Viyella
Vickers

FINANCIAL ORGANISATIONS INTERVIEWED

Advent
Cogent

Cranfield Institute of Technology

INCOME 1984-85

1. For purposes of comparison with the information about Universities' and Research Councils' income some information is set out below about the Institute's income for the year ended 31 July 1985 (source: Cranfield published accounts).

	£000s	% (rounded)
Education	25,228	59
Tuition fees	17,738	41
DES recurrent grant	7,490	17
Research, design, development and consultancy	14,158	33
Residences	2,137	5
Other	1,406	3
	42,929	100

2. For the immediately preceding years the comparable figures were as below:—

	1981-82	%	1982-83	%	1983-84	%
Education	11,625	53	13,547	55	14,788	51
TF	5,109	23	6,593	27	7,757	27
DES grant	6,516	30	6,954	28	7,031	24
Research etc	7,782	35	8,502	35	11,213	39
Residential	2,319	10	1,738	7	2,000	7
Other	379	2	671	3	900	3
Totals	22,105	100	24,458	100	28,901	100

